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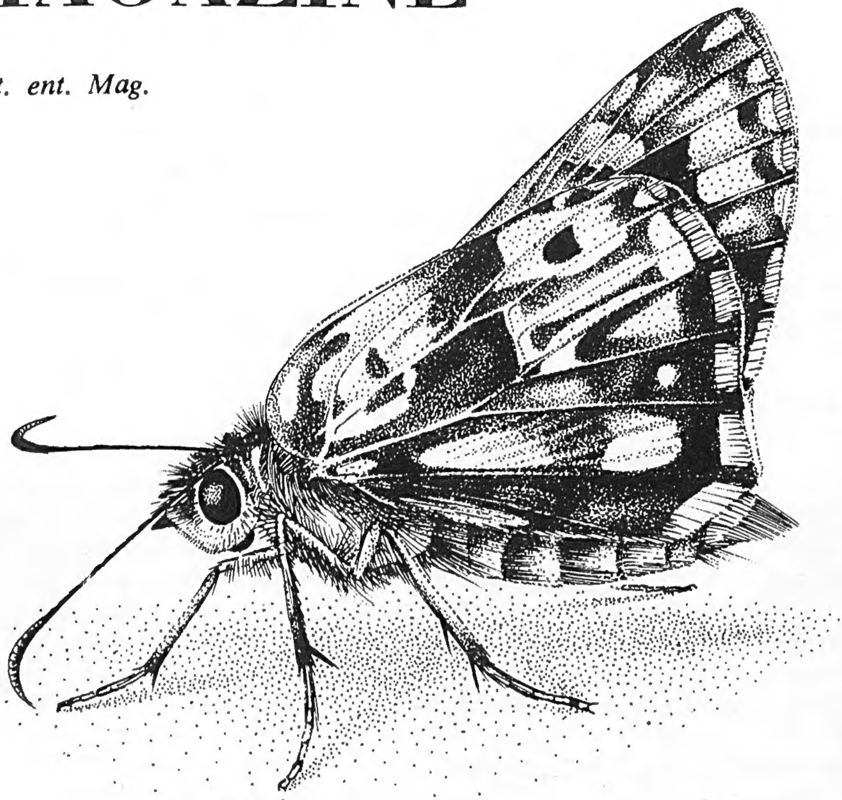

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COVER

Illustrated by Andrew Atkins

Hesperilla mastersi mastersi Waterhouse, 1900 (♀). This handsome skipper is distributed from southern Queensland to eastern Victoria, where it is restricted to temperate and subtropical rainforests and dense coastal thickets on cliff slopes. Adults fly from September to March but probably only have one generation each year. The semi-spherical eggs are laid singly beneath young leaves of the foodplant, *Gahnia melanocarpa* that grows in dark gullies. The brightly striped larvae and elongate pupae are found in tube-shaped leaf shelters within the foodplant and attached debris.

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NOTES ON THE TAXONOMY AND BIOLOGY OF SPECIES OF *PARASARCOPHAGA* JOHNSTON & TIEGS AND *BARANOVISCA* LOPES (DIPTERA: SARCOPHAGIDAE) ASSOCIATED WITH SPIDERS IN EASTERN AUSTRALIA

By B. K. Cantrell

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Abstract

Parasarcophaga cyrtophorae sp. n. is described and distinguished from the closely related species *Baranovisca arachnivora* Lopes and *B. reposita* (Lopes); the genus *Baranovisca* Lopes is discussed. Observations on the association between *P. cyrtophorae, B. reposita* and the spider *Cyrtophora moluccensis* (Doleschall) in Brisbane, Queensland are presented.

Introduction

Baranovisca reposita (Lopes) was originally described in *Parasarcophaga* Johnston & Tiegs from a single male from Sydney, New South Wales "feeding in a spiders cocoon", an unusual habit for a species of Sarcophagidae. The identification by Cantrell (1981) of a series of sarcophagid flied reared from the egg cases of the spider *Cyrtophora moluccensis* (Doleschall) (Araneidae) as *P. reposita* Lopes was thus based partly on conjecture because of host similarity. However comparison of specimens with Lopes' description and illustrations showed close resemblance. The incomplete holotype of *P. reposita* (the terminalia preparation was not available at that time) was then examined and found to be apparently identical to available specimens. With the identification seemingly correct, *P. reposita* was redescribed, including information on the female and the immature stages.

The redescription was made from specimens collected in Papua New Guinea and Brisbane, Australia during 1980. Observations of spiders continued in Brisbane in 1981-1985 and many more flies were recovered. The species is easily recognized by its distinctive puparium (Fig. 20) which lacks the deep posterior larval spiracular pit characteristic of most Sarcophagidae. The spiracles are fully exposed and surrounded by an oval peritreme marking the edge of the rudimentary pit of the third instar larva. Flies were usually found as either mature larvae or puparia in the host egg cases, having fed on the developing spiders eggs.

In 1983, a single puparium with a deep spiracular pit was found in an egg case. The female fly which emerged from it appeared to be identical in appearance to females which emerged from "pitless" puparia, but it was not possible to positively identify it. Collecting efforts were increased in 1984 and "pitted" puparia were recovered from two spider egg cases, from which two male and two female flies emerged. Examination of the terminalia of the males showed slight differences from those of specimens redescribed as *P. reposita* by Cantrell (1981). Moreover, they matched perfectly the original illustrations of the male terminalia of *P. reposita* made by Lopes (1959).

Cantrell (1981) assumed that the slight discrepancies between his illustrations and those of Lopes (1959) were due to difficulties in drawing the complex male terminalia. It is now apparent that the species redescribed by Cantrell (1981) was a new species, and that the true *P. reposita* was the species with a "pitted" puparium collected in small numbers in 1983 and 1984. Collecting in 1985 again produced low numbers of *P. reposita*, but showed that the new species (described below as *P. cyrtophorae*) is more commonly collected in the Brisbane area.

Lopes (1985) described a third species of Sarcophagidae known to be associated with spider eggs in Australia, naming it as the type species of a new genus, *Baranovisca.* The species is *B. arachnivora* Lopes, which was reared from an egg case of *Dicrostichus magnificus* Rainbow (Araniedae) in Sydney, New South Wales. He also transferred *P. reposita* (plus three non-Australian species) to *Baranovisca.* The defining characters of *Baranovisca* rely to a large extent on details of the male and female terminalia. The new species described below could also be included in *Baranovisca,* but I refrained from doing so, describing it instead in *Parasarcophaga.* The Australian sarcophagid fauna contains a number of small genera (largely erected by Lopes) differentiated by small differences in external morphology and terminalia from the two large genera, *Parasarcophaga* and *Tricholioproctia* Baranov. A thorough generic revision of the Australian Sarcophaginae is long overdue and until this is done (and *Baranovisca* retained or not), I prefer to adopt a conservative position for the species described below. Brown and Shipp (1978) also discussed the generic composition of the Australian Sarcophaginae following studies of wing morphometrics, and advocated the use of fewer, larger, genera for this group.

Having examined specimens of *B. arachnivora, B. reposita* and *P. cyrtophorae* it was possible to annotate distinguishing characteristics for each species based on the male and female terminalia. All three species are otherwise almost identical. Information on the relative abundance of *B. reposita* and *P. cyrtophorae* in Brisbane, also of their biology and that of their host (*C. moluccensis*) is presented below.

Abbreviations for specimen depositories are: AM, Australian Museum, Sydney; ANIC, Australian National Insect Collection, Canberra; QDPI, Queensland Department of Primary Industries, Brisbane; QM, Queensland Museum, Brisbane. Measurements of body length and ratio (V/HW) of width of vertex at level of posterior ocelli to maximum head width across eyes, both viewed dorsally, are expressed as means with ranges given in brackets. Number of specimens measured is shown last.

Parasarcophaga cyrtophorae sp. n.
(Figs 1-5, 14-16, 20)

Types.—*Holotype* ♂ Brisbane, QUEENSLAND, 28.ii.1984, B. K. Cantrell, ex egg case of *Cyrtophora moluccensis* (Doleschall), in QM. *Paratypes*, all same data as holotype except as indicated; 1 ♀ (QM); 1 ♂, 1 ♀, 4.iii.1984 (AM); 1 ♂, 1 ♀, 22.ii.1985 (AM); 2 ♂♂, 11+13, iii.1985 (ANIC); 2 ♀♀, 12.iii.1985 (ANIC); 1 ♂, 21.iii.1981, R. Raven (QDPI); 1 ♀, 22.iii.1981, R. Raven (QDPI); 1 ♂, 21.vi.1981 (QDPI); 1 ♀, 26.vii.1981 (QDPI); 1 ♂, 1 ♀, Feb. 1982 (QDPI); 1 ♂, 1 ♀, Mar. 1982 (QDPI); 1 ♂, 1 ♀, Aug. 1982 (QDPI); 1 ♂, 1 ♀, 7.iii.1983 (QDPI); 2 ♂♂, 2 ♀♀ (QDPI); 1 ♂, 1 ♀, 10.iii.1985 (QDPI); 1 ♂, 1 ♀, 16-17.iii.1985 (QDPI).

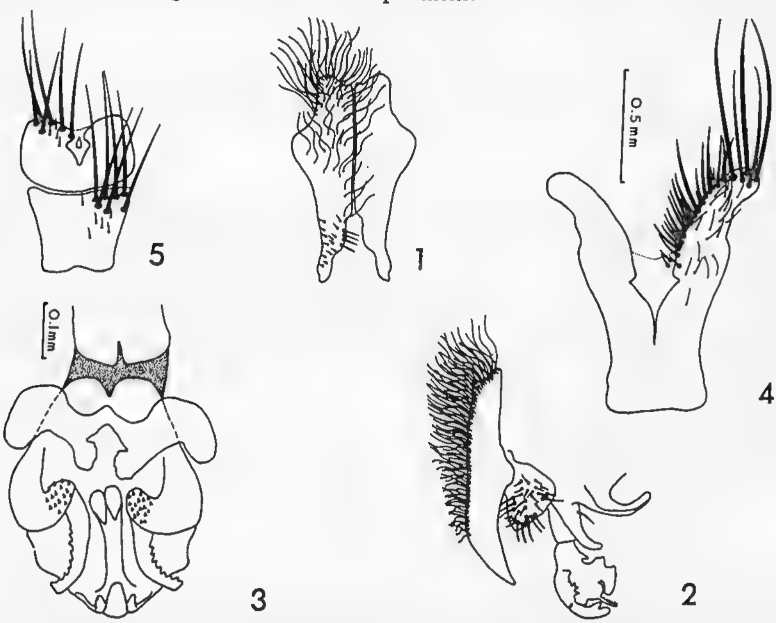
Non-type specimens examined.—Many specimens of both sexes, all Brisbane, Queensland, various dates between 1981-1985, from same host as holotype (QDPI), plus specimens listed by Cantrell (1981) as *Parasarcophaga reposita* Lopes (misidentification).

Description

For a full description of this species, including the immature stages, see pp. 29-33 of Cantrell (1981) under the heading *Parasarcophaga reposita* Lopes (misidentification) and Figs 1-5, 14-16, 20 below. Methods of differentiating this species from *B. arachnivora* and *B. reposita* are given below.

Measurements

Body length (mm): ♂ 9.7 (6.8-12.6); ♀ 9.8 (6.8-11.4). V/HW: ♂ 0.20 (0.19-0.22); ♀ 0.26 (0.24-0.28). (25 ♂♂, 25 ♀♀). Note that these values differ from those given by Cantrell (1981), being based on different specimens.



Figs 1-5. *Parasarcophaga cyrtophorae* sp.n. (1-4) male: (1) cerci, posterior view; (2) cerci, surstyli and aedeagus, lateral view; (3) tip of aedeagus, ventral view; (4) abdominal sternite 5, ventral view; (5) female abdominal sternites 6 and 7, ventral view. All to same scale except Fig. 3.

Etymology

The specific name alludes to the association between this fly and its only known host, *Cyrtophora moluccensis.*

Baranovisca arachnivora Lopes
(Figs 6, 8, 10, 12)

Baranovisca arachnivora Lopes, 1985: 51. Holotype ♂ (KS6986) in AM; type locality Hornsby Heights, New South Wales.

Specimens examined.—Holotype; paratype ♀ (AM), no locality label but associated with holotype by label on holotype "Sarcophagidae male, female, parasitic in egg sac *Dicrostichus magnificus*". The egg case (AM) from which these specimens emerged was also examined; it contains an additional male and female, both improperly emerged and deformed, plus empty puparia.

Notes

This species can only reliably be distinguished from *B. reposita* and *P. cyrtophorae* on terminalic characters (Figs 6, 8, 10, 12). The immature stages are unknown, but the puparium has a deep posterior spiracular pit. The adult measurements given by Lopes are accurate [Body length (mm): ♂, ♀, 9.0. V/HW: ♂ 0.17; ♀ 0.25.]

Baranovisca reposita (Lopes)
(Figs 7, 9, 11, 13, 17-19)

Parasarcophaga reposita Lopes, 1959: 65. Holotype ♂ in ANIC; type locality Sydney, New South Wales.

Baranovisca reposita: Lopes, 1985: 51.

Specimens examined.—Holotype; other specimens all Brisbane, QUEENSLAND, B. K. Cantrell, ex egg case *Cyrtophora moluccensis* except as indicated; all in QDPI; 1 ♀, 14.ii.1983, R. Haddrell; 2 ♂♂, 15.ii.1984; 1 ♀, 19.ii.1984; 1 ♀, 21.ii.1984; 5 ♀♀, 26.ii.1985; 1 ♀, 3.iii.1985; 1 ♀, 5.iii.1985; 1 ♂, 6.iii.1985; 1 ♂, 8.iii.1985.

Notes

This species is indistinguishable from *B. arachnivora* and *P. cyrtophorae* except by examination of the terminalia. Whole larvae were not available, but first and second instar exuviae recovered from a host egg case allowed examination of the cephalopharyngeal skeleton, while that of the third instar was recovered from an empty puparium. These are shown in Figs 17-19 and are clearly distinguishable from the corresponding photographs for *P. cyrtophorae.* In particular, note the lack of blunt cuticular spines on segment 2 of the first instar larva and the absence of the ventral spine on the mouthhooks of the third instar larva as seen in *P. cyrtophorae.* Puparia of the two species are also distinct as mentioned in the introduction.

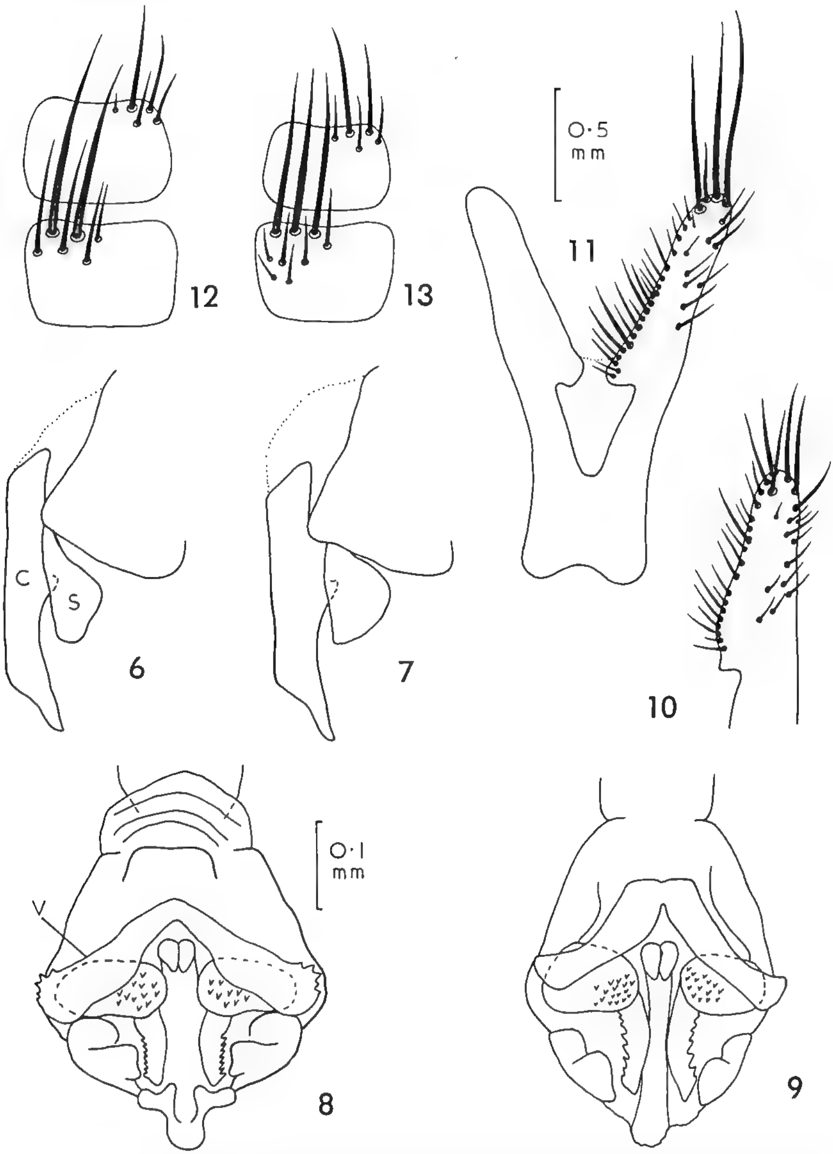
Measurements

Body length (mm): ♂ 9.6 (9.0-10.1); ♀ 8.6 (8.2-8.9). V/HW: ♂ 0.21 (0.20-0.22); ♀ 0.26 (0.25-0.27). (4 ♂♂, 10 ♀♀).

Species diagnosis

Adults of *P. cyrtophorae* may be distinguished from *B. arachnivora* and *B. reposita* as follows:

1. In the male by differences in the shape of the apical profile of the cerci (Figs 2, 6, 7) and ventralia of the aedeagus (Figs 3, 8, 9), also by the presence of more numerous and longer terminal setae on the lobes of abdominal sternite 5 (St5) (Figs 4, 10, 11).



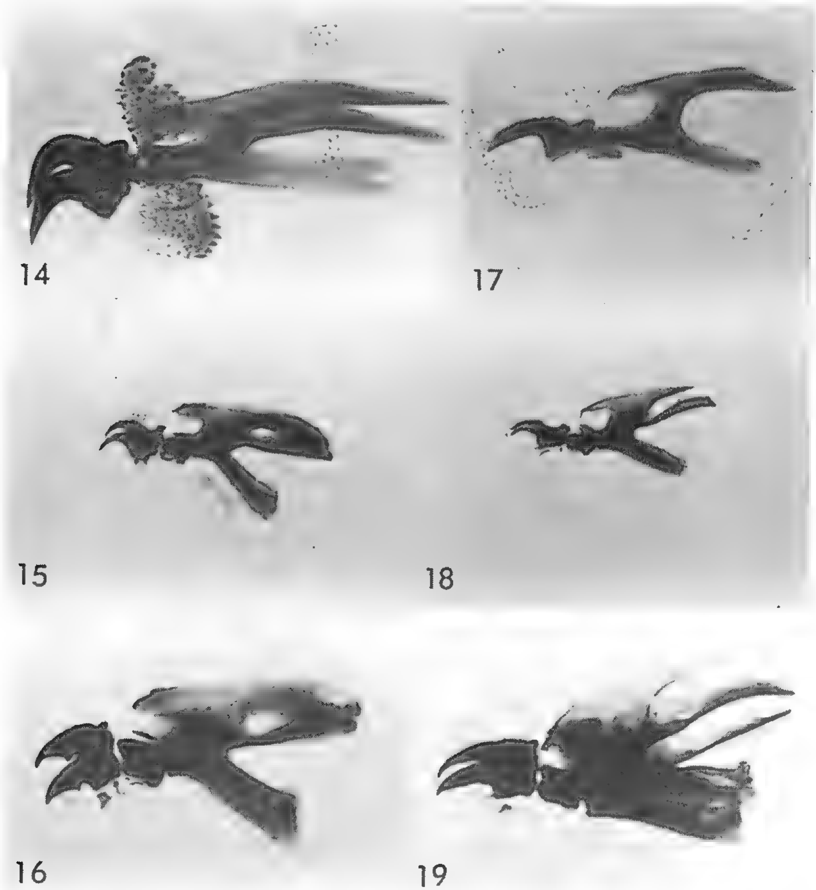
Figs 6-13. *Baranovisca arachnivora* (Lopes), left in each pair, and *B. reposita* Lopes, right in each pair. (6-11) male: (6, 7) cerci (c) and surstyli (s), lateral view; (8, 9) tip of aedeagus showing ventralia (v), ventral view; (10, 11) lobe of abdominal sternite 5, ventral view. (12, 13) female abdominal sternites 6 and 7, ventral view. All to same scale except Figs 8, 9.

2. In the female by the presence of a median decolourized area on the hind margin of abdominal sternite 7 (St7) (entire in *Baranovisca* spp.) and by the more numerous setae along this margin and that of St6. (Figs 5, 12, 13).

Adults of *B. arachnivora* and *B. reposita* are more difficult to separate:

1. In the male the cerci appear to be identical, but the shape of the surstyli in lateral view (Figs 6, 7) and the ventralia (Figs 8, 9) differ. Note also differences in the length of the terminal setae on the lobes of St5 (Figs 10, 11).
2. In the female, there are fewer setae on the hind margin of St6 in *B. arachnivora* than in *B. reposita* (Figs 12, 13).

Larvae of *B. arachnivora* are unknown. but those of *B. reposita* and *P. cvrtophorae* mav be separated by differences in the shape of the cephalopharyngeal skeleton (Figs 14-16, 17-19).



Figs 14-19. Cephalopharyngeal skeleton of larvae, lateral view. (14-16) *Parasarcophaga cyrtophorae* sp.n.: (14) first instar; (15) second instar; (16) third instar. (17-19) *Baranovisca reposita* (Lopes): (17) first instar; (18) second instar; (19) third instar.

Biology

During 1984 and 1985, egg cases of *Cyrtophora moluccensis* were examined for the presence of sarcophagids; any larvae or puparia recovered were reared to adults, when some were pinned and the others released after being sexed. Records were kept which trace the history of each egg case collected and the results are given in Tables 1-3. Spiders were observed at four suburban sites in Brisbane at Indooroopilly, Mitchelton, Rainworth and Yeerongpilly. Spiders were undisturbed until production of egg cases was generally well advanced, so that most spiders were guarding two or more egg cases when these were removed from the webs leaving the spider unharmed and the web damaged as little as possible. Many spiders produced further egg cases but these were not sampled.

In determining percentage predation, an egg case was considered to be attacked even if it contained only a single fly larva. In such cases, and those containing only a few larvae, not all the spider eggs were consumed so that some spiders successfully hatched.

The method of entry by the fly larvae into the spider egg cases is unknown. The cases are constructed in two halves held tightly together by an outer layer of webbing, and entry is probably made at some point along the join. Female flies were seen flying into webs and attempting to land on the string of egg cases, presumably to oviposit. Once the spider noticed the fly, she attempted to protect the egg cases by moving rapidly over them to prevent the fly from landing. In the few encounters observed the fly eventually left the web. Lubin (1974) gave greater details of observations on interactions between *P. cyrtophorae* (listed as an unidentified species of Sarcophagidae) and *C. moluccensis* in Papua New Guinea.

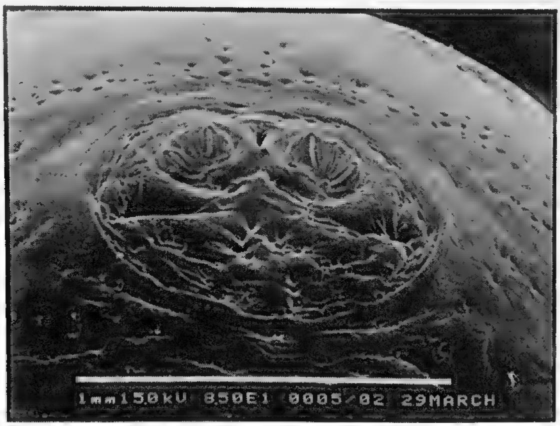


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Fig. 20. Scanning electron micrograph of posterior portion of puparium, *Parasarcophaga cyrtophorae* sp.n. Specimen platinum coated.

C. moluccensis is the only known host of the two species of sarcophagid recovered during the survey (*B. reposita* and *P. cyrtophorae*). The spider appears to be univoltine with mature females beginning to build obvious webs in early summer (November-December) and producing eggs mainly in January-March or April. It is not known whether the flies are also univoltine or if they have alternative hosts or breeding dites during the long period when eggs of *C. moluccensis* are unavailable.

Discussion

The three species of Sarcophagidae considered in this paper provide a good example of the difficulties encountered in the taxonomic study of Australian Sarcophaginae. Adult external morphology in this subfamily is generally very homogeneous, making it difficult to produce workable keys. The present generic concepts need to be revised using modern taxonomic methods [such as those employed by Brown and Shipp (1978)], and until this has been done there is little justification for the erection of further genera (such as *Baranovisca*). When a generic revision of our Sarcophaginae is eventually undertaken, the author responsible for it will be in a better position to take appropriate action on the several small genera.

Regardless of their generic identity, the three species under discussion are interesting because of their association with spiders, an unusual trait for sarcophagids which normally utilize carrion and similar decomposing organic matter as a larval medium. These are the only species of Sarcophaginae in Australia known to have such a habit but the species of *Baranovisca* are as yet poorly known, particularly in the immature stages (the immature stages of the non-Australian species of *Baranovisca* are unknown). Cantrell (1981) suggested that the broad blunt spines on segment 2 of the first instar larva of *P. cyrtophorae* and certain other features of later instar larvae such as reduced spination and absence of a deep posterior spiracular pit may be adaptations to its predatory life style. However, from what is known of the immature stages, *Baranovisca* spp. appear similar to typical sarcophagids. Thus the significance of the modifications in *P. cyrtophorae* remains uncertain, although its success in the study area may indicate that it is better suited to predation than, at least, *B. reposita*.

Table 3 shows the variability in rate of predation of *C. moluccensis* by *P. cyrtophorae* at different sites. The cause of such great variation was not investigated in this study. The table also illustrates relative abundances of *B. reposita* and *P. cyrtophorae* in the study area. Lubin (1974, Table 4) listed percentage parasitization of *C. moluccensis* by *P. cyrtophorae* in Papua New Guinea at rates ranging from 4.35% to 22.2%. The study area is the known northern limit of *B. reposita* and the known southern limit of *P. cyrtophorae*. The known southern limit of *C. moluccensis* is also southeast Queensland. It would be interesting to study predation of egg cases of related

TABLE 1
Summary of observations (pooled from all sites) on egg production and predation in *Cyrtophora moluccensis*, Brisbane, 1984 and 1985.

Year	Total no. spiders	Total no. egg cases	Mean per spider	Range	No. of affected egg cases	% predation
1984	57	166	2.91	1-6	27	16.2
1985	50	120	2.4	1-5	43	35.8

TABLE 2
Details (pooled from all sites) of predation of *Cyrtophora moluccensis* by *Parasarcophaga cyrtophorae* and *Baranovisca reposita*, Brisbane, 1984 and 1985.

Year	Species	No. of egg cases affected	% Predation	No. Predators	Mean per egg case	Range*	Sex ratio of emerged adults** ♂	♀
1984	*P. cyrtophorae*	25	15.0	83	3.32	1-6	28	37
1984	*B. reposita*	2	1.2	8	4	3-5	2	2
1985	*P. cyrtophorae*	39	32.5	128	3.28	1-7	32	44
1985	*B. reposita*	4	3.3	13	3.25	1-7	3	8

* 10 puparia of *P. cyrtophorae* were recovered from a single egg case in 1982.
** The discrepancy between the total of males plus females and the number of predators is because some flies died as immatures and others had already emerged as adults and escaped before sampling occured.

TABLE 3
Percentage predation of *Cyrtophora moluccensis* by *Parasarcophaga cyrtophorae* and *Baranovisca reposita* at four sites in Brisbane, 1984 and 1985.

Year	Species	% predation* at each site: Indooroopilly	Mitchelton	Rainworth	Yeerongpilly
1984	*P. cyrtophorae*	44.4 (7-18)	11.8 (43-118)	n.s.	10.0 (7-30)
1984	*B. reposita*	0.0 (7-18)	1.2 (43-118)	n.s.	0.0 (7-30)
1985	*P. cyrtophorae*	n.s.	35.0 (39-92)	57.1 (2-7)	32.5 (9-21)
1985	*B. reposita*	n.s.	3.0 (39-92)	0.0 (2-7)	4.0 (9-21)

n.s. = not surveyed.
* Figures in parentheses indicate the total number of spiders webs examined followed by the number of egg cases sampled for that site.

spiders in New South Wales to determine the nature of the predator complex, and if possible, find the host(s) of *B. reposita.*

B. arachnivora and *B. reposita* appear to be very closely related species and it would be useful to have larger series of each for study so that their relationship can be better determined. The type specimens of *B. arachnivora* emerged from an egg case of *D. magnificus.* Unlike those of *C. moluccensis* described above, egg cases made by this spider are larger, spindle shaped and have no apparent weaknesses in their outer covering, and it is unclear how the fly larvae gained entry. The single egg case examined was largely filled with loosely woven silk and the egg mass appeared to be smaller than in normal egg cases of *C. moluccensis,* perhaps indicating that *D. magnificus* is not as suitable a host. Studies of further egg cases of *D. magnificus* would be helpful in order to determine whether predation by *B. arachnivora* is a regular event.

Elgar *et al.* (1983) studied the biology of *C. hirta* (L. Koch) in Brisbane but apparently found no evidence of egg predation by sarcophagids. A single egg case of *C. hirta* examined in the present study was also undamaged. Elgar *et al.* (1983) found *Stathmopoda arachnophthora* (Turner) (Lepidoptera: Stathmopodidae) parasitizing eggs of *C. hirta* and commented that they knew of no other reports of lepidopteran parasitism in this spider genus. This moth was not noted in the present study but larvae of *Pyroderces* sp. (Lepidoptera: Cosmopterygidae) were regularly recovered from egg cases from which *P. cyrtophorae* had emerged. They appeared to be scavengers rather than parasites but perhaps deserve further investigation.

Acknowledgements

I thank Mr & Mrs H. J. N. Callaghan of Mitchelton for permission to study spiders on their property and for their tolerance of many spiders webs over extended periods of time; the Mitchelton site provided much of the data in this study. Mr & Mrs G. J. Dash allowed me to sample in their garden at Rainworth on one occasion. I am grateful to Mrs M. Agnew for the scanning electron micrograph, Miss J. F. Grimshaw for photographic assistance and providing some egg cases of *C. moluccensis* and Mr M. R. Gray (AM) for loan of specimens of, and information on, *B. arachnivora.*

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SOME EARLY STAGES OF *CALOCHRYSA* BANKS (NEUROPTERA, CHRYSOPIDAE)

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Abstract

Features of the egg, oviruptor and first instar larva of *Calochrysa extranea* (Esben-Petersen) are described. These stages indicate a close relationship between *Calochrysa* and *Italochrysa*, and confirm placement of the former in the Italochrysini.

Introduction

Calochrysa Banks is one of the few chrysopid genera believed to be endemic to Australia, where it is widely distributed (New, 1980). The genus includes only the type species, *C. extranea* (Esben-Petersen), and was allocated by Brooks (1984) to the tribe Italochrysini. Nothing has hitherto been reported on its early stages or biology and, in view of the increasing realisation of the importance of features of the immature stages for assessing relationships within the Chrysopidae, the egg, oviruptor and first instar larva are described in this note. The sparse material available consists of only one egg and its issue, and represents the sole output of a female adult captured at light in March 1985. The female was one of two taken at Hurstbridge, Victoria, representing a considerable extension of the known distribution of *Calochrysa* into the southeast of Australia.

The only other information available on early stages of Italochrysini is limited to the genus *Italochrysa* Principi (Principi 1946, New 1983).

Measurements are given in millimetres, and drawings are from slide-mounted material.

Calochrysa extranea (Esben-Petersen)

(Figs 1-9)

For synonymy see New (1980: 30).

Egg.–Elongate, tapered to narrow apex with prominent micropyle, laid on simple stalk; very fine areolate sculpturing visible under high magnification. Length 1.50, breadth 0.68, stalk 5.7. Pale bluish breen, changing to grey before hatching.

Oviruptor (Fig. 2).–Moderately sclerotised; a prominent rounded and slightly rugose anterior lobe; posterior elongate blade with incipient acute teeth.

First Instar (Figs 1, 3-9).–Body length, excluding mouthparts, 2.0; greatest head width 0.45. Very pale, with part of vertex slightly browned as in Fig. 1; abdomen predominantly colourless, setae pale. Strongly humped, with head partially retracted. Head appendages short; palpi (Fig. 4) medially convergent, about as long as mandibles, preapical segment with three or four setae, apical segment narrow and tapered with few fine setae at tip; mandibles and maxillae basally stout and strongly curved, short; apex of mandible (Fig. 5) slender and incipiently serrate on inner edge; apex of maxilla (Fig. 6) narrowly

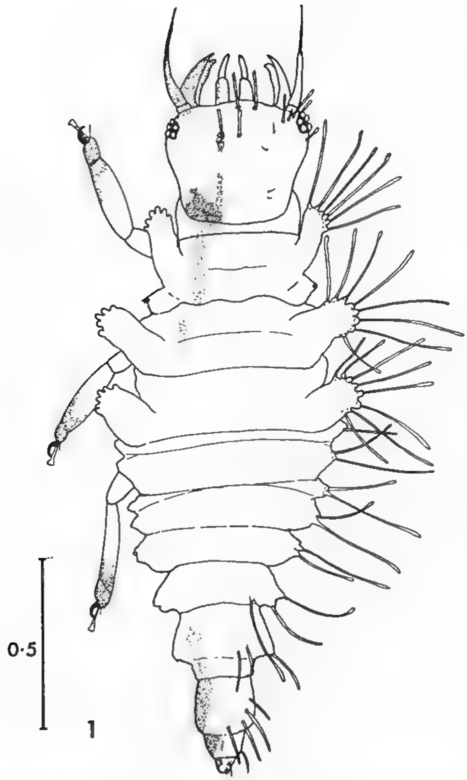
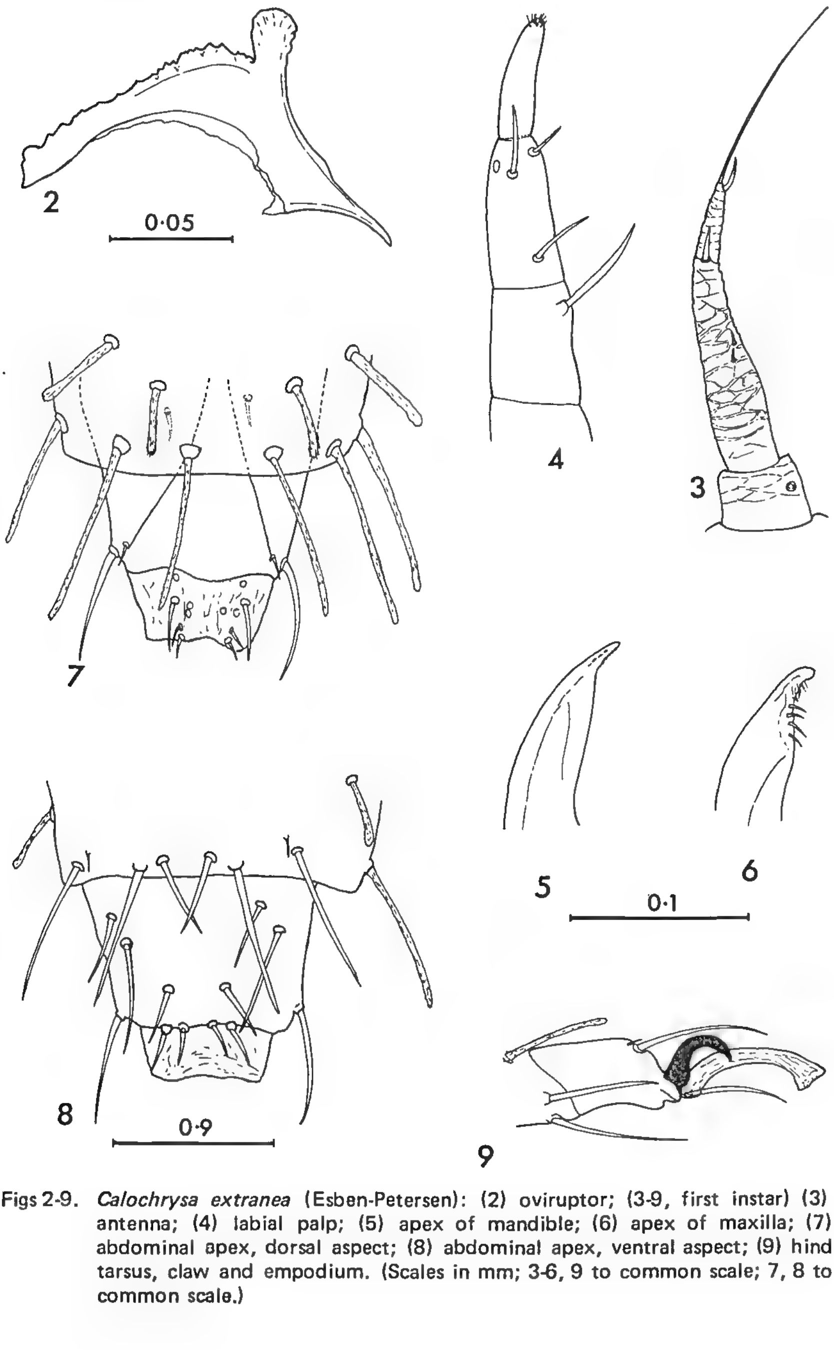


Fig. 1. *Calochrysa extranea* (Esben-Petersen): first instar larva, dorsal aspect (setae omitted from left side, legs and pigmentation omitted from right side, scale in mm).

blunt, with about four short setae and fine filaments beyond these. Antenna (Fig. 3) strongly tapered, about 1.3 times mandible length and about equal to medial head length; a long terminal filament with one seta at base of this and another, more basal, seta; irregular reticulate sculpturing. Dorsal labral margin of head with four long, blunt, slightly ridged setae; two or three shorter blunt setae anterior to each eye, and one blunt marginal seta behind each eye; a long blunt seta on vertex behind each medial labral seta; three or four minute pointed setae approximately in line along vertex behind inner mandible base. Eyes in black surround.

Thoracic segments each with well-developed and dorsally-reflexed lateral lobe, each lobe bearing six to eight long blunt setae arising from separate basal tubercles. Abdominal segments I-VII each with tapered lateral lobe bearing two or (VI, VII) three similar setae, one being conspicuously longer than the other on segments I-V. Other conspicuous dorsal setae absent, but dorsum of thorax and abdomen I-VI with dense vestiture of long slender filaments,



Figs 2-9. *Calochrysa extranea* (Esben-Petersen): (2) oviruptor; (3-9, first instar) (3) antenna; (4) labial palp; (5) apex of mandible; (6) apex of maxilla; (7) abdominal apex, dorsal aspect; (8) abdominal apex, ventral aspect; (9) hind tarsus, claw and empodium. (Scales in mm; 3-6, 9 to common scale; 7, 8 to common scale.)

some of them hooked (not shown in Fig. 1). Apex of abdomen as in Figs 7, 8: dorsal setae predominantly blunt and ornamented, ventral setae predominantly tapered. Legs with setae slightly ornamented; claw strongly arched; empodium long (Fig. 9).

Material Examined.—Victoria, Hurstbridge, 1 egg ex female at light 16.iii.1985; hatched after 6 days under uncontrolled conditions.

Discussion

The insect described above bears an extraordinary resemblance to the corresponding stages of *Italochrysa insignis* (Walker) (New, 1983), and strongly supports Brooks' (1984) alliance of the two genera. The anterior process of the oviruptor is longer and more rounded in *Calochrysa* than in *Italochrysa*, but the whole structure is clearly of the same general pattern. It differs substantially from the oviruptors of other Chrysopinae which have been described in having the anterior process considerably enlarged.

The first instar larvae of the two genera share the following features of likely phylogenetic value in defining larvae of the tribe Italochrysini:—

i. Debris-carrying, with strongly developed dorsal entangling vestiture.
ii. Short body, with abdomen strongly humped and head partially retracted into prothorax.
iii. Jaws and palpi very short.
iv. Dorsal thoracic plates not developed.
v. Dorsal labral margin of head with few blunt setae; posterior half of head with no long setae.
vi. Pronounced thoracic lobes on all segments, each with few long setae.
vii. Anterior abdominal segments with lateral lobes each bearing two or three long setae, these not hooked.

The main differences between the larvae are rather trivial: all major setae of *Calochrysa* are relatively shorter than those of *Italochrysa*, and there are minor differences in cranial seta pattern. Perhaps more notably, the major lateral setae of *Calochrysa* are bluntly rounded rather than tapered.

The larva became coated with debris soon after eclosion. It was provided with various *Eucalyptus* psyllids and scale insects and, although it was seen to probe these, died within about a week. It is possible, in view of the close resemblance to *Italochrysa*, that it may have a similarly-specialised larval life in close association with ants (Principi, 1946).

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A SMALL PORTABLE LIGHT TRAP FOR COLLECTING MICROLEPIDOPTERA

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Abstract

A small portable, transparent light trap, using a 6 watt actinic light source operated by a 12 volt battery, is described and figured. The trap segregates in separate compartments larger fast-flying from small slow-flying insects and has proved to be especially useful for the collection of microlepidoptera.

Introduction

Light traps are widely used for the collection of insects, especially to monitor pest populations, but also for insect surveys and to provide museum specimens. Whatever their use, the trapped specimens should be in good condition to aid identification, and this is essential when traps are to provide specimens for taxonomic study. Lepidoptera are especially vulnerable to damage when large numbers of beetles and other hard-bodied insects are collected with the moths in a small container. Microlepidoptera can often be denuded when they share a light-trap container with large fast-flying Lepidoptera. During the warmer months in Australia christmas beetles (*Anoplognathus* spp.; Scarabaeidae), as well as bogong moths [*Agrotis infusa* (Boisd.)] and other noctuid moths, are often attracted to lights in large numbers and can rapidly destroy small soft-bodied insects with which they come in contact before they themselves succumb to the killing agent used in the trap.

In order to lessen this problem, a transparent light trap was designed (Common 1959) using a 125 watt mercury vapour discharge lamp operated by a 240 volt generator or the mains supply. This excluded most of the larger scarab beetles and segregated the few that did enter the trap from most of the Lepidoptera. The principles of this design were later adapted for a fixed weather-resistant light trap (Common and Upton 1964), which performed well throughout the year at Canberra, Australian Capital Territory, for a period of some 15 years. For use in field work, however, especially in situations in which it is impracticable to operate a generator, a small transparent trap has been designed, utilizing a 6 watt actinic blue fluorescent tube. This trap has now been in use for a number of years and has proved to be very efficient for the collection of microlepidoptera in most habitats.

I have observed consistently that fast-flying moths tend to circle a light source and, when they come into contact with the lamp or the sides of a trap funnel, fall into the trap. Slow-flying moths, on the other hand, and especially microlepidoptera, tend to approach a light source up-wind close to the ground. They often land on the ground or on low-growing vegetation, intermittently walking or fluttering towards the light and sometimes remaining motionless for a time on vegetation or leaf litter. In designing the new trap, therefore, these behaviour patterns have been exploited to segregate as far as

possible the fast-flying larger moths from the slow-flying microlepidoptera, and to exclude scarab beetles. It had already been shown (Common 1959) that a transparent trap collected far fewer Scarabaeidae than an opaque trap; those scarabs that approached the light source tended to land on the ground in the illuminated area surrounding the transparent trap and either became immobile or crawled around beside the trap without entering it.

Description of the trap

The trap (Figs 1-3) is constructed of clear "Perspex" 3 mm in thickness and is in the form of a rectangular box (I) 236 mm long, 152 mm wide and 154 mm high, open at the top with the edges bevelled inwards, and with a line of 3 mm drainage holes drilled in the middle of the bottom. In each of the four sides, 22 mm from the top, there is an elongate slot (H) 5 mm wide and extending to within 20 mm of each corner. Above each slot a ledge (G), which projects 8 mm, diverts into the trap insects that crawl upwards and also prevents rain entering the slots. In a compartment (L) divided off by "Perspex" at one end of the trap, the converter from a 6 watt, 12 volt battery lantern is installed and wired to an inlet and outlet on the outside of the trap. In the remainder of the bottom of the trap sits a rectangular tray (K) with 12 mm sides and two 12 mm walls that divide off a central elongate section 25 mm wide; a series of drainage holes drilled through the middle of this section match those in the bottom of the trap. About 72 mm above the bottom a second rectangular tray (J) with 25 mm sides sits on two strips glued to

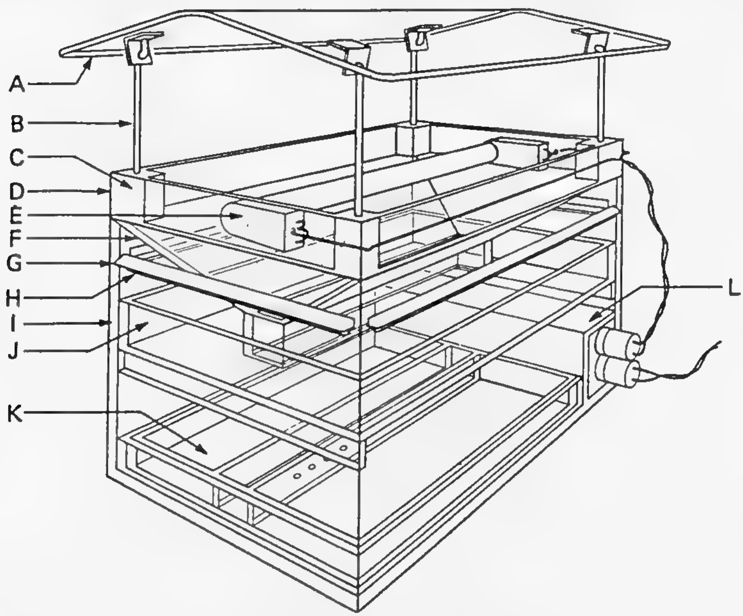

Fig. 1. The assembled portable light trap

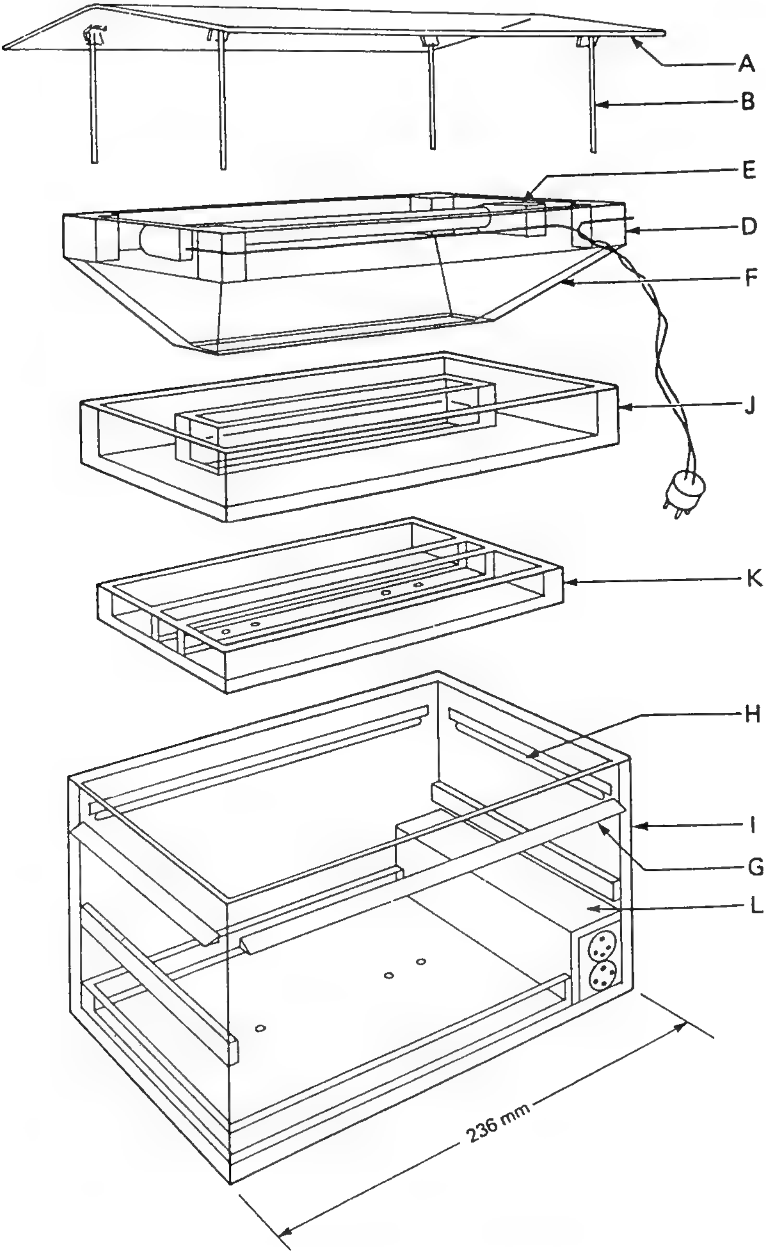

Fig. 2. An exploded view of the trap components.

each end of the trap. In the centre of this tray there is a slot 170 mm long and 17 mm wide, surrounded by 25 mm sides. A funnel (F) with the same outside dimensions as the body of the trap sits on the top. This is rectangular with 25 mm vertical sides (D) above, which continue below at an angle of 52° to the vertical to an opening 170 mm long and 17 mm wide that rests accurately on the edges of the central slot in the upper tray. On the inner surface of each of the vertical ends of the funnel the holders (E) for the horizontal 6 watt actinic blue tube are fitted, with wiring leading to the power outlet from the converter. In each corner of the funnel a 16 mm square "Perspex" block (C), with a 3.5 mm vertical hole drilled in its centre, is glued. A transparent, slightly bent rectangular cover (A), 205 mm by 280 mm, has four folding wire legs (B) 110 mm long which fit into the holes at the corners of the funnel. The cover is placed in position only if rain threatens.

Discussion

The trap is operated on the ground so that the light source is visible from above and the surrounding area is illuminated. A small area of soil, slightly larger than the base of the trap, is cleared of vegetation and levelled, and the trap is either placed firmly on the loosened soil so that insects cannot crawl beneath it, or placed on a thin piece of particle board or cardboard. Ants are sometimes a problem, but I have found that they can be discouraged by spraying the soil beneath the trap and the lower side of the particle board with a household spray before setting up the trap.

Tetrachloroethane is used as an anaesthetic or killing agent in the trap. This is dispensed from three shallow aluminium dishes about 45 mm in diameter. In each there is a 7 mm layer of vermiculite covered by a 7 mm layer of plaster of Paris, through which there is a central hole stoppered by a cork. Each dish is charged with about a millilitre of tetrachloroethane by an eyedropper through the hole in the plaster, although more may be necessary during warm weather. Two plaster dishes on the upper tray of the trap and one on the lower have proved adequate. It should be remembered that tetrachloroethane is a solvent of "Perspex" and a dish can inadvertently be glued to the plastic if any solvent is left on the outside of the dish.

The trap is operated with a 12 volt acid motor-cycle battery or a 12 volt nickel-cadmium rechargeable battery, either of which will give more than 10 hours of continuous light. However, in warmer weather when insects are abundant, it is often desirable to limit the operating time with a time switch. This also allows the trap to be operated for any desired period during the night.

Fast-flying moths and other insects that tend to circle the light enter the trap through the funnel at the top and are directed to the lower storey of the trap. Slow-flying moths that crawl up the sides of the trap enter it through the slots near the top and are immobilized on the upper tray. The 5 mm wide slots normally prevent the entry of bogong moths and larger species. The removable upper and lower trays allow the catch to be sorted next morning without undue disturbance to the specimens collected.

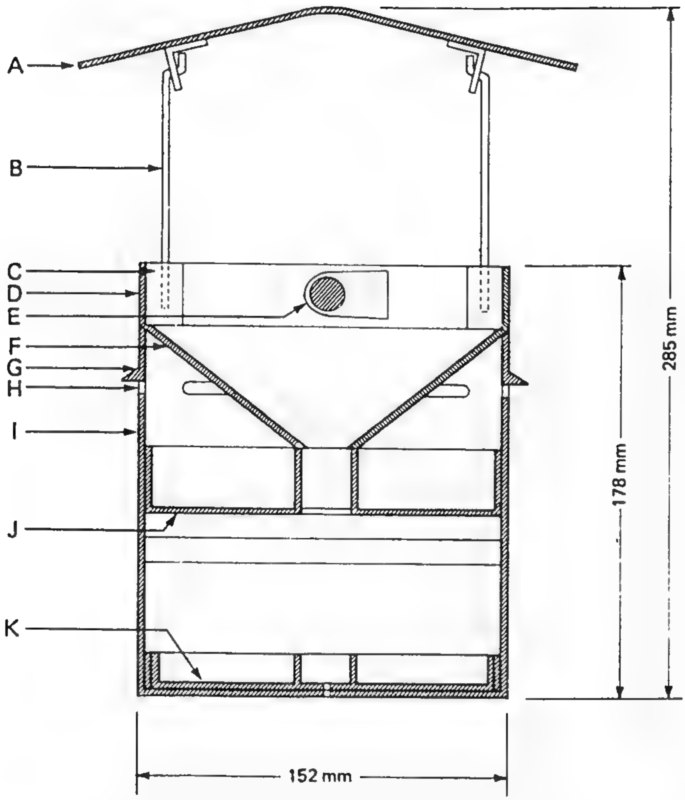

Fig. 3. A vertical section through the light trap.

The low wattage actinic blue tube is very attractive to moths and other insects but, since the light is not reflected to any extent by surrounding trees and other objects, the trap is not noticeable to humans unless the light is in their direct line of vision. This makes it very useful for sampling habitats close to busy thoroughfares and human settlements. However, care should be taken to select a position for the trap screened in some way from view. The compact design and the light weight of the trap also make it useful for collecting in habitats that are not accessible to vehicles.

Acknowledgement

Thanks are due to Mr Ian Sharp for the line drawings.

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SOME EARLY STAGES OF *CHARAXES LATONA* BUTLER (LEPIDOPTERA: NYMPHALIDAE: CHARAXINAE)

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Abstract

Two instars and the pupa of *Charaxes latona* Butler are described and a food plant listed.

Introduction

Within Australian limits *Charaxes latona* is only known from the Claudie River area (Common and Waterhouse, 1981). Specimens may be taken throughout the year. Males frequent hilltops but females are more often seen flying along roads and watercourses. While examining lauraceous plants at Iron Range a single charaxid larva was found. This was raised on the netted food plant and proved to be *Charaxes latona.*

Early stages

Third(?) instar. Head rough with two pairs of long horns, inner pair, top and perimeter of head black, outer pair and remainder of head brown. Body green, covered with minute yellow granules, dorsum of sixth segment with a semicircular white area, margined black. Final segment with a pair of short, brown, backward-pointing processes. Length 14 mm.

Final instar (Fig. 1). Head granulose, green, perimeter pale brown, with two pairs of long horns and two pair of short pointed projections between these, the horns and apex of projections dark brown. Body green, covered with minute yellow granules. Sixth segment with a semicircular pink area margined white and then black. Eighth and tenth segments bear subdorsal circular patches of white, margined black. Granules within all black areas pale blue. Final segment processes yellow, joining a yellow lateral line. Length 47 mm.

Pupa (Fig. 2). Stout, smooth, shiny, green, with two irregular white bands on wing cases and pale white markings on remainder. Length 27 mm.

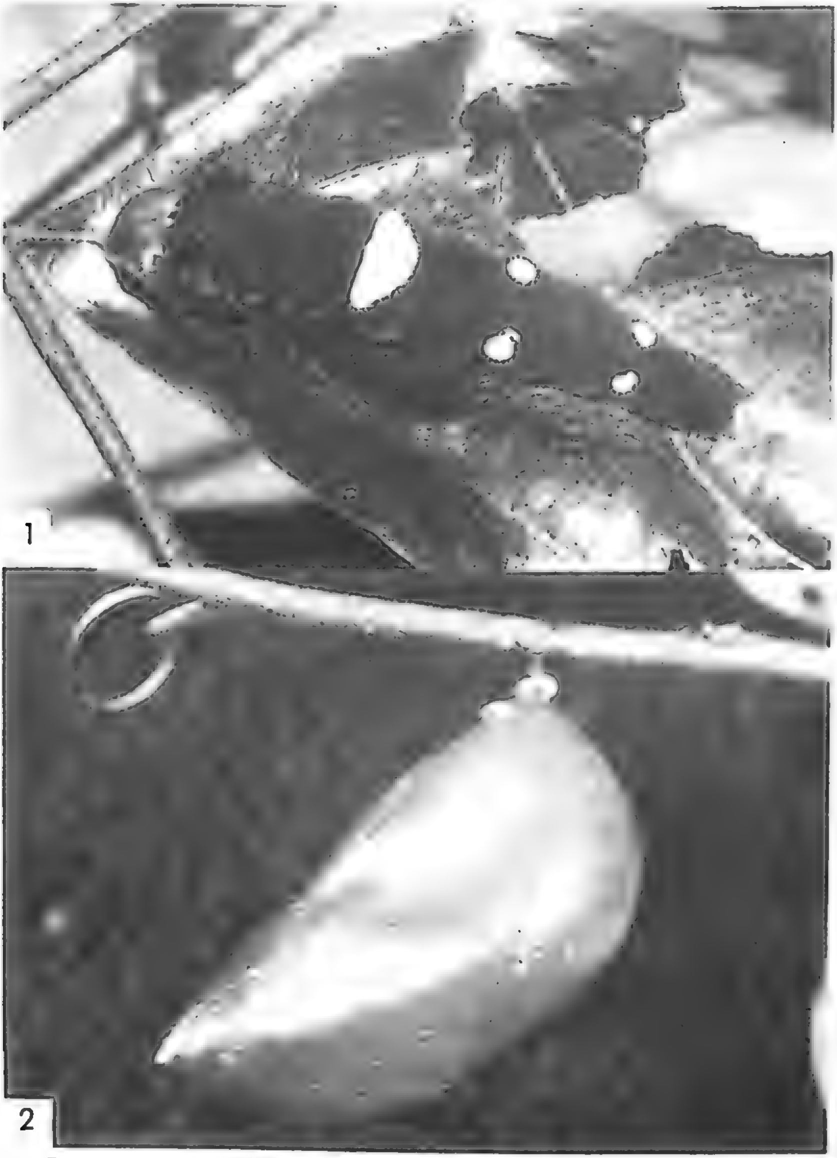
Larval food plant. Cryptocarya triplinervis R.Br. Lauraceae.

Notes

A single larva was found on the 12th July resting on a silken pad at the centre of a leaf. I enclosed the branch in a netting bag and the larva completed two more instars, pupating beneath the branch on 12th September, the adult emerging on 28th September.

Acknowledgement

I wish to thank Mr B. P. M. Hyland, Division of Forest Research, C.S.I.R.O. Atherton, for identifying the food plant.



Figs 1, 2. *Charaxes latona*: (1) final instar larva at rest on food plant; (2) pupa.

Reference

Common, I. F. B. and Waterhouse, D. F., 1981. *Butterflies of Australia.* Second edition. Angus and Robertson, Sydney. 682 pp.

OBSERVATIONS ON *LIPHYRA BRASSOLIS* WESTWOOD (LEPIDOPTERA: LYCAENIDAE) IN NORTH QUEENSLAND

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Abstract

Larvae of *Liphyra brassolis* Westwood (Lepidoptera: Lycaenidae) are recorded feeding upon larvae of *Oecophylla smaragdina* F. (Hymenoptera: Formicidae). Descriptions are given of early instar larvae together with brief comments on habitat, larval abundance and adult morphology.

Introduction

Since the discovery of the larvae of *Liphyra brassolis* in the arboreal nests of *Oecophylla smaragdina* (Dodd, 1902) very little has been published on the life history of this fascinating insect. In his original account, Dodd observed a large larva of *L. brassolis* sieze a larva of *O. smaragdina* but he disturbed the *L. brassolis* larva before it could feed. Subsequent publications listing *L. brassolis* have presumed the larvae to be carnivorous on the intermediate stages of *O. smaragdina* on the basis of this single observation. (Waterhouse and Lyell, 1914; Waterhouse, 1932; Common and Waterhouse, 1981).

Further weight was given to this assumption by Chapman (1902) when he described the mouthparts of larval *L. brassolis* as piercing type mandibles within a suctorial tube formed by labium, maxillae and labrum.

Early instar larvae have not subsequently been encountered or described. The description of one by Chapman (1902) was not of a larva of *L. brassolis* but of a moth larva, most probably *Cyclotorna monocentra* (Cyclotornidae). Dodd (1903) had inadvertently included the small moth larva with the samples of *L. brassolis* larvae sent for description.

In June and July 1985, in a search of two locations in north Queensland, the authors located all the intermediate stages of *L. brassolis* and successfully reared several large larvae in the laboratory.

Field observations

On 14th June a search was made of *O. smaragdina* nests in a disused citrus orchard of more than 150 trees at Dallachy creek 20 km north of Cardwell, where larvae of *L. brassolis* were known to occur (H. Bosworth, pers. comm.). Twenty-three final instar larvae and one pupa were taken, of which all but one larva were confined to trees at one end of the orchard. A peripheral tree on the corner of this area contained 14 larvae with a maximum of 6 in one nest.

Waterhouse (1932) recorded pupal exuviae on Great Palm Island near Ingham and as extensive citrus orchards were known to have been established on the island, a search was undertaken on 15th July. Only a few scattered

remnants of the original orchards remained, and one area comprising ten stunted trees infested with *O. smaragdina*, contained a substantial breeding colony of *L. brassolis.* Intermediate stages of *L. brassolis* were present in five trees with the majority being found in only two trees.

One tree with five ant nests contained a total of twenty-seven final instar larvae, pupae and fresh pupal exuviae as well as two first instar larvae. A second small tree had two ant nests, one of which was devoid of ant brood but contained two cast larval skins of *L. brassolis.* The second nest had a few ant larvae and pupae and contained eight small pupae, four final instar and two first instar larvae of *L. brassolis.*

Another small tree had a single small ant nest devoid of ant larvae and pupae and within which were a cast larval skin and a dead advanced larva of *L. brassolis.* Numerous eggs, in groups of up to six, were present on the undersides of exposed sections of trunk and branches of several trees. The distribution of larvae between nests is shown in fig. 1.

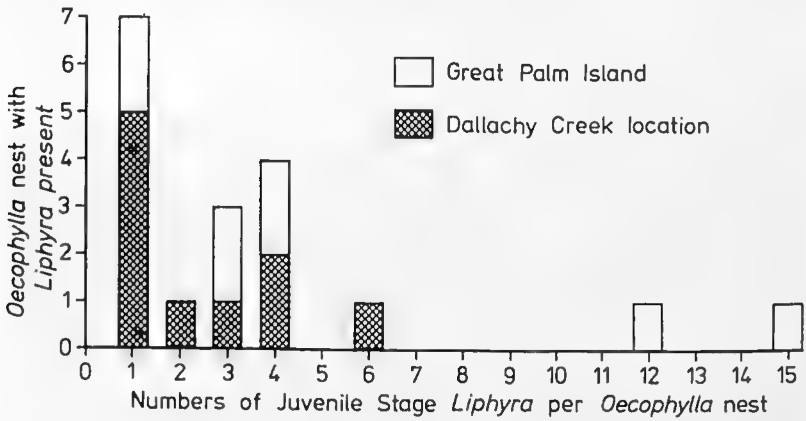

Fig. 1. Density of *Liphyra brassolis* larvae in nests of *Oecophylla smaragdina.*

First instar larva (Fig. 2)

Oval shaped, 6 mm long and 4 mm wide and flattened. Dorsum yellow with dorsolateral lines of 7 reddish spots and medially 3 transverse grooves. A concentric pair of reddish brown submarginal lines. Marginal fringe white, composed of thin, radially arranged chords with club shaped ends forming a finely sculptured edge and capable of close appression to leaf surface. Ventral surface white, bearing mid ventrally, the head, thoracic legs and abdominal prolegs.

Second instar larva

Similar to first instar but colour becoming brownish yellow and marginal fringe thickened and reddish brown in colour. Length 10 mm and width 6 mm.

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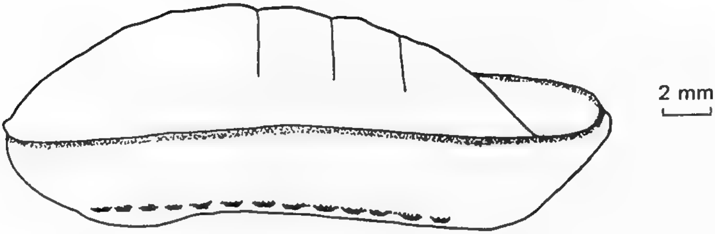

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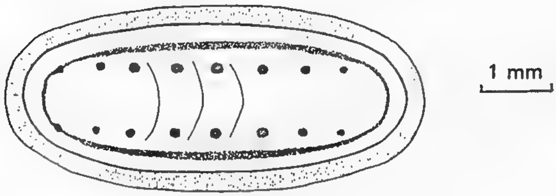

Figs 2, 3. First instar larva and prepupa of *Liphyra brassolis.*

Prepupa (Fig. 3)

Resembling final instar larva but becoming swollen and convex anteriorly while retaining the upturned posterior margin. Duration 5-6 days after which posterior surface expands dorsally. Pupal duration at a constant temperature of 25 degrees C. ranged from 27-32 days and at room temperature at Townsville was 30-46 days. The egg was described by Waterhouse and Lyell (1914) and the final instar larva and pupa by Chapman (1902).

Laboratory observations

Larvae returned to the laboratory were introduced into transparent plastic cylinders containing small colonies of *O. smaragdina.* Most wandered within the cage for 24-48 hours before either pupating or commencing to feed. The *L. brassolis* larvae that fed, located and remained in close proximity to aggregations of ant larvae and pupae attended by adult ants.

When foraging, the *L. brassolis* larvae located ant larvae with their antennae and larger prey were given a light coating of silk. The prey was then grasped by the tarsal claws of the thoracic legs, withdrawn under the projecting rim and held along the ventral midline so that one end of the prey was presented to the mouthparts (Fig. 4). The ant larva was then consumed by vigorous chewing of the mandibles combined with a pharyngeal suction to ingest liquid contents. In most cases the prey larva was entirely consumed but with an occasional large prey larva a small remnant was discarded.

Small ant larvae were eaten either singly or in adherent clusters by being seized in the mouthparts without the use of the forelegs. Only ant larvae were eaten; ant pupae when encountered were rejected by being pushed to one side with the head.

Adult

Adult males emerging from pupae from both locations exhibit extensive melanic colouration of the upperside and underside of both fore and hind wings. Females have slightly broader dark margins to the wings and more prominent dark cell spots on the hind wings. An adult male from Townsville taken in January and a female from Darnley Island in May have the more extensive orange areas on all wings normally associated with *L. b. major.*

Discussion

In both habitats, *L. brassolis* larvae were found in *O. smaragdina* nests in citrus trees growing in a cleared area in open forest and riverine rainforest. It has been the experience of the authors and others (H. Bosworth and J. Young pers. comm.) that larvae are more often encountered in ant nests in single isolated trees. It is not thought that female *L. brassolis* are attracted to citrus trees but Lokkers (1982) in a study of the behavioural ecology of green tree ants, at Townsville, discovered that ants are more likely to occupy areas of higher tree density. It is possible that orchards provide an appropriate tree density for the development of successful colonies of *O. smaragdina.*

In both locations the *L. brassolis* larvae were confined to only a few ant nests in some of the available infested trees. The exceptional numbers of larvae in two of the nests at Great Palm Island had undoubtedly resulted

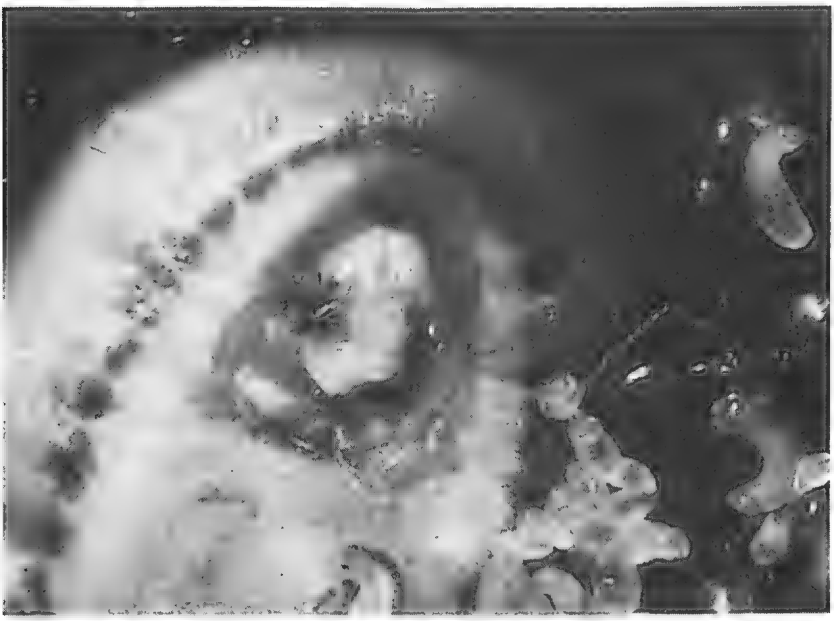

Fig. 4. Mature larva of *L. brassolis* ingesting a larva of *O. smaragdina.*

from larval congregation at diminished food supply. No explanation can be given for the spatial distribution of *L. brassolis* larvae between trees. Within some trees the presence of *L. brassolis* larvae in a particular ant nest appeared to be determined by the position of the nest relative to the oviposition site. The feeding and successful rearing of numerous larvae of *L. brassolis* on larvae of *O. smaragdina* confirms the original suspicions of Dodd. The finding of first instar larvae within ant nests would indicate that all larval instars feed upon ant larvae. The finding of a dead larva in a nest devoid of ant larvae and stunted pupae in nests almost exhausted of ant larvae would indicate that *L. brassolis* larvae have an exclusive diet of *O. smaragdina* larvae.

The postulation by Chapman (1902) that *L. brassolis* larval mouthparts were suctorial was an accurate interpretation. When the mandibles are retracted beneath the labrum, the broad cardines of the maxillae close the preoral cavity laterally from labrum to labium. The circular orifice thus formed is well adapted to enclose the end of cylindrical prey larvae. The dentate mandibles are effective cutting and chewing appendages enabling ingestion of the cuticle of prey larvae.

Waterhouse and Lyell (1914) described *L. b. melania* based on 3 dark males from the Northern Territory but it is now known that there is no geographical basis to this colour form. Examination of more specimens from summer generations may indicate if there is any seasonal basis to this melanic colouration.

Acknowledgements

We wish to thank Mr H. Bosworth for providing access to his orchard and Mr G. Jones for assistance with photography.

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STUDIES ON THE MIGRATION OF *DANAUS PLEXIPPUS* (L.) (LEPIDOPTERA: NYMPHALIDAE) IN THE SYDNEY AREA

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Abstract

Field data on migration of *Danaus plexippus* (L.) in the Sydney area are presented. Autumn migration is predominantly coastward, with butterflies following northerly, north-easterly, easterly and south-easterly flight paths. Limited data indicate the possibility of return southerly migration following dispersal of overwintering colonies.

Introduction

In North America wanderer butterflies, *Danaus plexippus* (L.) vacate summer breeding grounds during autumn and migrate south-south westwards to overwintering areas in California and Mexico (Urquhart and Urquhart 1977, 1978). During spring, the butterflies begin a north-north easterly return migration repopulating the summer breeding areas with individuals that may have travelled up to 6000 km (Urquhart and Urquhart 1979). In 1963 the Australian Museum in Sydney with the assistance of field cooperators, began a tagging programme to investigate *D. plexippus* migration in eastern Australia. To date no large scale directional movements have been discovered, although a unidirectional flight was observed in April 1963 south of Sydney close to overwintering sites (Smithers 1965). A summer extension and winter contraction of range does occur in eastern Australia (Smithers 1977), but the importance of long distance migration is unknown. A *D. plexippus* tagging project in New Zealand gave no indication of seasonal long distance movement or migration although some long flights were recorded (Wise 1980).

Data from earlier studies strongly indicate that autumn migration to overwintering sites is a feature of *D. plexippus* biology in New South Wales (Smithers 1965, 1977; James 1982, 1983, 1984a, b, c). However, information on the extent and orientation of migration is lacking. Evidence for post-overwintering migration is scanty although a northerly movement has been reported (Common and Waterhouse 1981). This paper presents information on migratory and non-migratory movements of *D. plexippus* in New South Wales. Field observations of migration are reported together with data on dispersal of butterflies from migratory and overwintering colonies. Information on orientation of migrants and non-migrants is also presented.

Methods

Migrating *D. plexippus* observed during 1981-84 were recorded together with information on location, time, direction of flight and weather. Migrating *D. plexippus* are characterised by purposeful and sustained leisurely flight, often within a few metres of the ground (Urquhart 1960). A single direction is maintained with flight continuing over obstacles, such as trees and buildings,

rather than around them. When captured and released, migrants return to their original course. This contrasts sharply with the flight shown by non-migrants which is often of a rapid flapping nature. When confronted by obstacles, or released after capture, non-migrants invariably deviate from their original course.

During 1980-82 butterflies were tagged at migratory or over-wintering cluster sites as described elsewhere (James 1982, 1984b, c). Inclusion of a telephone number on tags enabled retrieval of information on movement after leaving cluster sites.

TABLE 1

Field observations of migrating *D. plexippus* in the Sydney area 1981-84.

Date	Location	Direction	Weather	Remarks
1981				
12.iv	Watsons Bay	E	sunny 22C, E wind	1 heading seawards
13.iv	Vineyard	NE	o'cast 25C, W wind	2, 5 min. apart
25.iv	Freemans Rch.	NE	sunny 22C, W wind	1
20.viii	Rydalmere	S	sunny 21C, calm	1 post-cluster
21.viii	Rydalmere	S	sunny 19C, calm	1 post-cluster
22.viii	Windsor	S	sunny 17C, calm	1 post-cluster
1982				
12.iv	Freemans Rch.	NE	sunny 23C, NW wind	1
14.iv	Cobbity	NE	sunny 26C, calm	1
24.iv	Luddenham	NE	sunny 28C, calm	1
26.iv	Campbelltown	NE	sunny 20C, calm	6, 2 min. apart
26.iv	Bulli	NE	sunny 22C, E wind	1
26.iv	N Wollongong	NE	sunny 22C, E wind	2, 5 min. apart
26.iv	Currans Hill	NE	sunny 23C, SW wind	2, 5 min. apart
1983				
8.v	Glossodia	N	sunny 24C, NW wind	1
1984				
29.ii	Regentville	NE	sunny 22C, S wind	1
1.iii	Faulconbridge	N	sunny 18C, S wind	1
6.iii	Parramatta	N	sunny 24C, NE wind	1
6.iii	Toongabbie	SE	sunny 24C, NE wind	1
7.iii	Emu Plains	E	sunny 24C, NE wind	1
14.iii	Blacktown	N	sunny 21C, W wind	1
14.iii	Blacktown		sunny 21C, W wind	1
15.iii	Ryde	N	sunny 24C, SW wind	1
21.iii	Picton	N	o'cast 20C, S wind	2, 5 min. apart
23.iii	St. Marys	NE	o'cast 23C, SE wind	2, 5 min. apart
25.iii	Castle Hill	NE	o'cast 20C, NE wind	1
6.iv	Faulconbridge	E	sunny 17C, NE wind	1
7.iv	Camden	NE	sunny 24C, calm	6, 10 min. apart
7.iv	Cobbity	N	o'cast 21C, calm	1
21.iv	Merrylands	E	sunny 19C, NW wind	1
27.iv	Rydalmere	E	sunny 18C, W wind	1
4.v	Toongabbie	E	o'cast 18C, calm	1

TABLE 2
Data on movement of *D. plexippus* after leaving cluster sites

Tagging date	Cluster	Recapture location and date	Direction and distance from cluster	Remarks
12.iv.81	Picton	The Oaks 20.iv.81	10 km N	Autumn northerly migration. Picton cluster 1981 & Wallacia/ Camden clusters 1982 were migratory during April/May (James 1982, 1984a, b)
12.iv.81	Picton	Werombi 2.v.81	15 km N	
2.v.82	Camden	Menangle Park 26.vi.82	7 km N	
23.v.82	Camden	Camden 9.vi.82	1 km N	
25.v.82	Wallacia	Wallacia 13.vi.82	3.5 km N	
25.iv.82	Camden	Picton 21.vii.82	10 km SW	Mid-winter post-cluster "return migration"
9.v.82	Camden	Yerrinbool 9.vii.82	35 km SSW	
6.vi.82	Camden	Tahmoor 17.vii.82	15 km SSW	

An earlier study reported data on the extent of movement shown by mass-released reproductive (non-migrant) and non-reproductive (migrant) *D. plexippus* (James 1983). Data on flight orientation on butterflies in this study are presented here.

Results

Field observation of migrating D. plexippus

Observations on migrating *D. plexippus* are summarised in Table 1. Twenty eight of the 31 observations occurred in autumn and were of butterflies flying in an easterly, northerly, or most commonly, north-easterly direction. The remaining three observations of butterflies flying southward, occurred in late winter and were possibly post-cluster movements. Most observations occurred during warm, sunny weather with little or no wind. Butterflies were often observed flying into light headwinds.

Movement of D. plexippus *after leaving cluster sites*

Information obtained on the movement of *D. plexippus* after leaving cluster sites is shown in Table 2. Only eight of more than 3,500 butterflies tagged in clusters during 1980-82 were subsequently recaptured away from the sites. Three tagged in the 1982 Camden overwintering colony were recaptured 10-35 km south west of the site, after the colony had broken up. Five butterflies tagged in autumn migratory colonies were recaptured 1-15 km northward before the dispersal of overwintering clusters.

Flight orientation of migrant and non-migrant D. plexippus

Data on flight orientation of 55 non-migrants and 103 migrants recaptured after autumn release and presented as percentages of butterflies recovered in the four major compass sectors are shown in Fig. 1. The few butterflies that flew true north, south, east or west were equally divided between adjacent sectors. Non-migrants radiated relatively evenly from a central point while migrants showed a clear preference for easterly flight orientation.

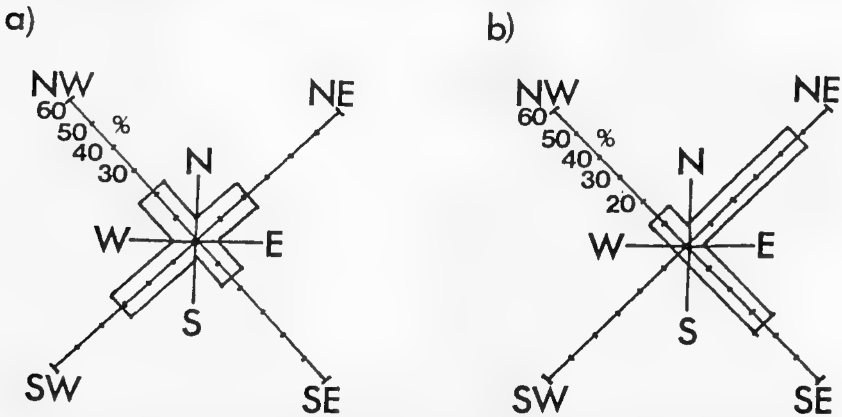

Fig. 1. Orientation of migrant (a) and non-migrant (b) *D. plexippus.* Data represents percentages of recaptures made in north-east, north-west, south-east and south-west sectors after autumn mass releases.

Discussion

The data presented here, although limited, are consistent in indicating that a coastward migration of non-reproductive *D. plexippus* occurs during autumn in New South Wales as suggested by earlier studies (Smithers 1965, 1977; James 1982, 1983). Observations suggest that a northerly or north-easterly direction is most often taken, while the orientation data indicate major north-east and south-east movement. Some evidence for a return south-westward migration, following the break-up of overwintering colonies, was obtained from field observations and the recapture of butterflies tagged in winter clusters.

The relatively small populations of *D. plexippus* in New South Wales makes autumn migrants less noticeable than they are in North America (Urquhart 1960). However, the large population in autumn 1982 resulted in an abundance of migrants in south-western areas of the Sydney basin, with many found dead on the roads. Most migrants flew alone, although on a number of occasions some were following the same route, a few minutes apart. The majority of migrants followed a north-easterly course. The data on flight orientation of autumn released non-reproductive *D. plexippus* also

indicate a substantial coastward movement. North easterly movement was also shown by nine migrants recaptured at distances of 10-380 km after release near Canberra (James 1983). In contrast reproductive butterflies show no preference in flight orientation.

Only three of more than 3,500 butterflies tagged at cluster sites were recovered after overwintering colonies had dispersed. These three showed south-westerly movement of 10-35 km, which is considered to have represented a return migration. If there is a strong south to south-west post cluster movement, it would result in butterflies entering relatively sparsely populated tableland areas thus greatly limiting the probability of recapture. The direct observations of three butterflies migrating southwards in August 1981 provides further evidence of a return southerly movement.

These results, together with earlier data (James 1982, 1984b) demonstrate that a regular north to north-east migration of *D. plexippus* occurs during autumn in New South Wales. This results in the withdrawal of butterflies from southern and western areas of New South Wales, and their accumulation in milder coastal areas where overwintering colonies are formed. From limited data, it is postulated that some return southerly movement occurs in mid-late winter when clusters disperse.

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BOOK REVIEWS

The leafhoppers and planthoppers edited by L. R. Nault and J. C. Rodriguez. September 1985. 500 pp., illustr. John Wiley & Sons. Distributed in Australia by Jacaranda Wiley, Brisbane. Price $137.90.

This book contains a wealth of information and is the culmination of contributions to a symposium held in honour of Dwight M. De Long by the Entomological Society of America. The Preface states "Our intent was to produce a book that would not only serve to introduce the subject matter to the student or investigator about to study leafhoppers and planthoppers for the first time, but would also be useful to specialists already in the field. The systematics and morphology of these homopterans are discussed and keys to the most economically important groups are included with illustrations. Internal morphology, sensory mechanisms of feeding, nutrition and symbiosis, acoustic communication, host plant resistance, transmission of plant pathogens . . . are among the important topics discussed." These aims have been achieved admirably. Twenty-four authors, all prominent workers in their field, have written the 19 comprehensive, review-like chapters. The scope of the text is broad and I have no doubt it would contain something of special interest to every reader. Each chapter is accompanied by an extensive list of primary literature references concerning the chapter topic. There is no wasted space throughout the 500 pages of this book, it is written in an easy to understand style, is adequately illustrated and I found no typographical errors. While I am a homopterist I do not work on either leafhoppers or planthoppers; nevertheless I found this book of considerable interest and a valuable reference. Despite the price I have no hesitation in recommending *The leafhoppers and planthoppers* to others and believe it should be in the library of every teaching and research institution concerned with entomological investigation.

Max MOULDS

A guide to the genera of beetles of South Australia. Part 4. By E.G. Matthews. 1985. 68 pp., illustr. South Australian Museum, Adelaide. Price $10.50.

This may well be the most popular of the four parts of this series so far published. It contains, in addition to 15 other families, the Buprestidae or jewel beetles which are popular amongst amateur coleopterists and naturalists. There are three colour plates of jewel beetles in addition to the many black and white beetle figures which are included in all parts; in this part there are 108 such figures. The illustrated keys of Part 4 fill 28 pages, the beetle illustrations another 22 pages and the text discussing families another 11. The four parts of this work now form a valuable and comprehensive reference to the South Australian beetle fauna. I am sure all interested in this field will find Part 4 particularly useful and like many others I look forward to Part 5.

C. HOLMES

SOME NEW RECORDS OF PSOCOPTERA FROM NORFOLK AND PHILLIP ISLANDS

By C. N. Smithers
The Australian Museum, College Street, Sydney.

Abstract

Cerobasis questfalicus, Lepinotus patruelis and *Propsocus pulchripennis* are recorded for the first time from the Norfolk-Phillip Island group. Eight species are recorded for the first time from Phillip and one from Norfolk Island. Eleven of the total of nineteen species appear to be endemic to the islands.

Introduction

Work on the insects of Norfolk Island and nearby Phillip Island has increased in recent years largely due to interest in the conservation of the fauna of these now very different islands. Smithers and Thornton (1974) gave an account of the Psocoptera which included fourteen species from Norfolk one of which was also recorded from Phillip. Smithers (1980) recorded another from Phillip and later (Smithers, 1981) provided a summary of records which included sixteen species, one of which was found on both islands and one of which was still known only from Phillip.

A recent collection of nearly 600 specimens, now in the Australian National Insect Collection includes three additional species. Table 1 gives a summary of the known occurrence of species on the islands. In the table the "endemic" column includes species which have not yet been recorded from anywhere other than Norfolk and/or Phillip Island.

Comments

Of the nineteen species listed sixteen are known from Norfolk and ten from Phillip. Nine are known from Norfolk but not from Phillip and three are known from Phillip but not Norfolk. Brief comments on habitat preferences were made by Smithers (1981). Little need be added other than to mention that *C. questfalicus, L. patruelis* and *P. pulchripennis* are probably all litter inhabitants on the islands.

The extent of collections made between 1968 and 1984 make it unlikely that many more species will be found on the islands.

Material of species previously unrecorded from Norfolk and Phillip Islands

TROGIIDAE

Cerobasis questfalicus (Kolbe). 3 ♀, 1 nymph, Phillip Island, Upper Long Valley, 26.iii-2.iv.1984, J. E. Feehan.

Lepinotus patruelis Pearman. 1 ♂, 1 ♀, Norfolk Island, Broken Pine Track, N.I.N.P., 15.xi.1984, L. Hill. 1 ♀, Norfolk Island, Rocky Point Reserve, 14.xi.1984, L. Hill.

ELIPSOCIDAE

Propsocus pulchripennis (Perkins). 2 ♂, 1 ♀, Phillip Island, Moo-oo Beach, 20-24.xi.1984, T. A. Weir. 1 ♀, Phillip Island, Upper Long Valley, 20-24.xi.1984, T. A. Weir.

Acknowledgements

I would like to thank the several collectors who contributed the material studied for this paper and Ms J. Cardale for making it available to me from the A.N.I.C.

TABLE 1
Summary of Psocoptera records for Norfolk and Phillip Islands.

	Norfolk Island		Phillip Island		'Endemic"
	Previously recorded	Present in ANIC material	Previously recorded	Present in ANIC material	
LEPIDOPSOCIDAE					
Pteroxanium ralstonae	x	x			x
Pteroxanium evansi	x	x		x	x
Pteroxanium insularum	x		x	x	x
Lepolepis graemei	x	x		x	x
TROGIIDAE					
* *Cerobasis guestfalicus*				x	
* *Lepinotus patruelis*		x			
CAECILIIDAE					
Caecilius pacificus	x	x		x	x
Caecilius insulatus	x				x
ECTOPSOCIDAE					
Ectopsocus briggsi	x	x			
Ectopsocus insularis	x	x		x	x
Ectopsocus inornatus	x	x			x
Ectopsocus richardsi			x		
PERIPSOCIDAE					
Peripsocus milleri	x	x		x	
Peripsocus norfolkensis	x	x		x	x
PSEUDOCAECILIIDAE					
Heterocaecilius variabilis	x	x			x
PHILOTARSIDAE					
Haplophallus emmus	x	x			x
ELIPSOCIDAE					
* *Propsocus pulchripennis*				x	
PSOCIDAE					
Blaste lignicola	x	x			
MYOPSOCIDAE					
Myopsocus australis	x	x			
Totals	15	14	2	9	
	16		10		11
	19				

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BOOK REVIEW

Natural History of Eyre Peninsula edited by G. R. Twidale, M. J. Tyler and M. Davies. Published 12th November, 1985. 229 pages, illustr. Royal Society of South Australia (Inc.), Adelaide. Price $18.50

This book is the fourth in a series of regional natural histories of South Australia published by the Royal Society of S.A. Like its predecessors the standard of presentation and content is high. The authors of the eighteen chapters are all recognised experts in their fields and the book is an authoritative account of the natural history of the region. There are two chapters on insects–Ch. 15, Distribution Patterns of Some Beetles by E. G. Matthews and Ch. 16, Moths and Butterflies by P. B. McQuillan and R. H. Fisher. Other chapters mainly concern other animal groups, vegetation, climate and geology. It is a fascinating and informative text to be recommended to all interested in the natural history of this region. However, it is slightly disappointing to see that none of the reptile, fish and insect photographs are in colour, as this greatly assists in the identification of species. South Australian naturalists, in particular, are indeed fortunate to have this and the other titles in the series available to them.

R. B. LACHLAN

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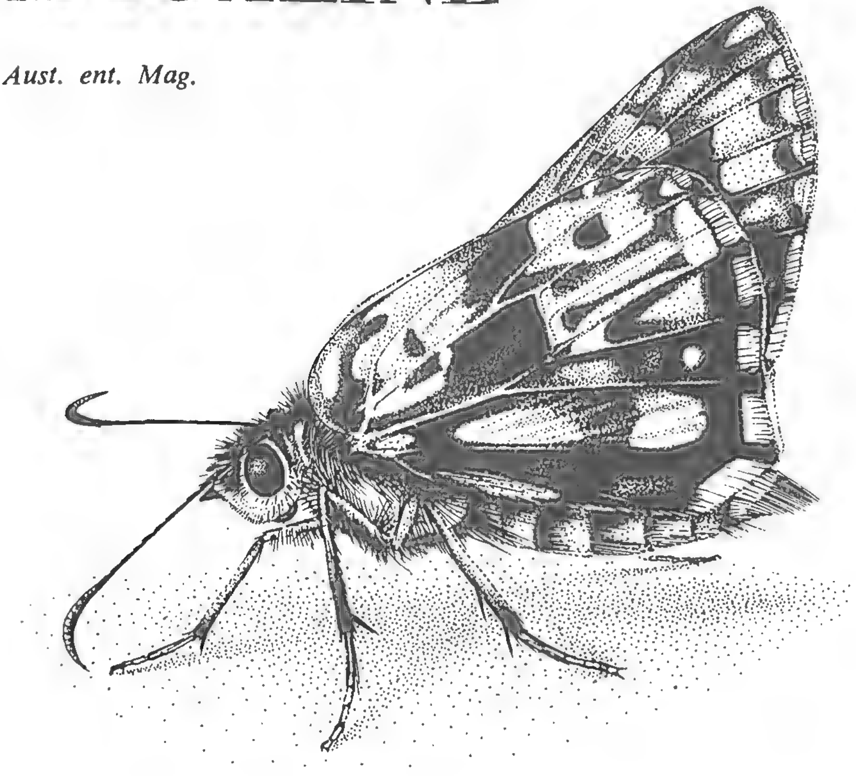

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COVER

Illustrated by Andrew Atkins

Hesperilla mastersi mastersi Waterhouse, 1900 (♀). This handsome skipper is distributed from southern Queensland to eastern Victoria, where it is restricted to temperate and subtropical rainforests and dense coastal thickets on cliff slopes. Adults fly from September to March but probably only have one generation each year. The semi-spherical eggs are laid singly beneath young leaves of the foodplant, *Gahnia melanocarpa* that grows in dark gullies. The brightly striped larvae and elongate pupae are found in tube-shaped leaf shelters within the foodplant and attached debris.

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THE HAWK MOTHS (LEPIDOPTERA: SPHINGIDAE) OF CHRISTMAS ISLAND, INDIAN OCEAN

By M. S. Moulds
Research Associate, Australian Museum, 6-8 College St, Sydney, N.S.W. 2000

Abstract

Details are recorded from three collections of hawk moths from Christmas Island previously unstudied. The known species from the island are listed and two species, *Macroglossum prometheus* Boisduval and *Hippotion depictum* Dupont are recorded for the first time.

Introduction

Christmas Island, Indian Ocean, lies some 360 km south of the Indonesian island of Java and 1400 km from Western Australia. It is isolated from other landmasses and although small (approximately 137 sq km), is covered for the most part in lush tropical rainforest ideally suited to hawk moths.

Although Ridley (1891) briefly records a "Sphingida, sp." the first specific listing of hawk moths is that of Hampson (1900) who records five species. Tweedie (1933) reports on taking three of the species listed by Hampson and later Pendlebury (1947) records two additional species making a total of seven species known from the Island. There has been no further mention of Christmas Island hawk moths by any author.

Recently the island was visited by Mr Robert B. Lachlan (RBL) who collected many insects including a number of hawk moths which he kindly allowed me to study. Additional material is also now available in the collections of the Australian National Insect Collection (ANIC) and Western Australian Museum (WAM). From all this material I summarise below the hawk moths now known from Christmas Island including two previously unrecorded species, *Macroglossum prometheus* Boisduval and *Hippotion depictum* Dupont.

List of species

Agrius convolvuli (L.)

Material examined.—1 ♀, Christmas Is., 29.i.1985, R. B. Lachlan (RBL). 2 ♂♂, Settlement, 5, 15.x.1964, T. G. Campbell; 1 ♀, Settlement, 25.x.1964, Mr Maxwell (ANIC).

There are records for January, March, April and October but reported by Pendlebury (1947) as "fairly common all through the year".

Psilogramma menephron menephron (Cramer)

Material examined.–4 ♀♀, Christmas Is., 21,23,25.i.1985, R. B. Lachlan (RBL, MSM). 1 ♂, Settlement, 25.x.1964, T. G. Campbell (ANIC).

There are records for October, December and January. Listed by Hampson (1900) as *Pseudosphinx discistriga* Walker.

Cephonodes picus picus (Cramer)

Material examined.–1 ♀, Blowhole, 29.vi.1961, G. F. Mees, WAM Reg. No. 85/1123; 1 ♂, ? Christmas Island, WAM Reg. No. 85/1124 (WAM). 4 ♂♂, 1 ♀, Christmas Is., 12,13.i.1985, R. B. Lachlan (RBL, MSM). 8 ♂♂, 7 ♀♀, Settlement, 2-25.x.1964, T. G. Campbell (ANIC).

Recorded by all previous authors. Pendlebury (1947) adds that it is "common in open spaces through the dry weather". There are records for Sep.-March, May.

Listed by Hampson (1900) as *C. hylas* (L.). *C. picus* is clearly distinguished by the spines present at the bases of the fore tibia which are absent in *C. hylas.*

Gnathothlibus erotus erotus (Cramer)

Material examined.–1 ♂, 1 ♀, Silver City, 6.ix.1969 and 3.x.1969, S. Slack-Smith and A. Paterson, WAM Reg. Nos 77/216 and 85/1122 (WAM). 3 ♂♂, 2 ♀♀, Christmas Is., 16,20,25,29.i.1985, R. B. Lachlan (RBL, MSM). 1 ♀, Settlement, 15.x.1964, R. Ashley; 1 ♀, Settlement, 13.x.1964, D. Cougle; 1 ♀, Settlement, 12.x.1964, T. G. Campbell (ANIC).

A common species recorded for July to January, March and May.

Daphnis placida placida (Walker)

Material examined.–1 ♂, Settlement, 2.x.1964, T. G. Campbell (ANIC).

Previously recorded only by Pendlebury (1947). Specimens have been taken during October, January and March.

Macroglossum prometheus prometheus Boisduval

Material examined.–1 ♀, ? Christmas Island, WAM Reg. No. 77/218 (WAM).

Previously unrecorded from Christmas Island. The WAM specimen which matches perfectly the specimen figured in Bell and Scott (1937) bears a question mark on its locality label but most likely did come from the Island. This is a common species in Java (Dupont and Roepke 1941) but a rarity in Australia where it is known only from subspecies *lineatum* Lucas occurring in the extreme north east of Northern Territory and north-eastern Queensland (Moulds 1985).

Hippotion velox (Fabricius)

Material examined.–2 ♂♂, Flying Fish Cove, 27.vi.1961 and 7.vii.1961, G. F. Mees, WAM Reg. Nos 77/209 and 77/210 (WAM). 2 ♂♂, 1 ♀, Christmas Is., 23,25.i.1985, R. B. Lachlan (RBL, MSM). 4 ♂♂, 1 ♀, Settlement, 5-19.x.1964, T. G. Campbell; 1 ♂, Settlement, 21.x.1964, D. Powell (ANIC).

There are records for all months from June to April. Recorded by all previous authors; listed by Hampson (1900) as *Chaerocampa vigil* (Guér.).

Hippotion depictum Dupont

Material examined.–2 ♂♂, 6 ♀♀, Christmas Is., 16,24,26,29,30,31.i.1985, R. B. Lachlan (RBL, MSM). 1 ♂, 2 km WSW of Waddle Hill, x.1964, L. Hill (ANIC).

Previously unrecorded from Christmas Island.

Theretra latreillei lucasii (Walker)

Material examined.–2 ♂♂, Christmas Is., 27,29.i.1985, R. B. Lachlan (RBL).

Hampson (1900) and Pendlebury (1947) record a single specimen each taken in December and May respectively.

Discussion

The sphingid fauna of Christmas Island is clearly allied to that of Java rather than to Australia. All species so far known from Christmas Island are abundant in Java (cf. Dupont and Roepke 1941) while only *A. convolvuli* occurs in Western Australia.

I would expect the sphingid fauna of Christmas Island to be considerably larger than that now known. The food plants, or plants closely related, of many Javanese hawk moths occur on the island (compare plant list of Ridley 1906, with Dupont and Roepke 1941) and it would not be unreasonable to expect the associated hawk moths. Further collecting during, and immediately after, the wet season should not only add to the list of known species but should also reveal the larval food plants used by these moths on Christmas Island. For the benefit of intending collectors I provide below a key to last instar larvae of the species known from Christmas Island compiled from a study of exotic material.

Key to last instar larvae

It should be noted that the colour of larvae of a given species can often show considerable variation, both in the arrangement of markings and in ground colour. For most species two principle colour forms occur, a predominantly green form and a predominantly black (sometimes brown) form.

1. Abdominal segment 1 (and often other abdominal segments with a subdorsal "eye spot" (dorsal to spiracle) 2
– Abdominal segment 1 without an "eye spot" (not to be confused with a spot that may surround spiracle) 5

2. "Eye spot" on abdominal segment 1 similar in size and colour to "eye spot" on at least two other segments . . . . *Gnathothlibus erotus erotus*
– "Eye spot" on abdominal segment 1 unique, clearly of different pigmentation from any other abdominal "eye spot" that may be present 3

3. "Eye spot" on abdominal segment 1 always with some red pigmentation. . . . . *Theretra latreillei lucasii*
– "Eye spot" on abdominal segment 1 without red pigmentation 4

4. Caudal horn curved forwards, long (about equal to body diameter); "eye spot" on abdominal segment 1 only, the other segments clearly without "eye spots" . . . . *Hippotion velox*
– Caudal horn straight or nearly so, short (less than half body diameter); subdorsal "eye spots" or blotches on abdominal segments 1-7, those on segments 2-7 similar but clearly different from that on segment 1. . . . . *Hippotion depictum*

5. Caudal horn curved backwards 6
— Caudal horn either straight, almost straight, or gently curved in a shallow 'S' 7

6. Head with each cheek bearing at least one distinct, dark, vertical stripe . . . . *Agrius convolvuli*
— Head of uniform colour without vertical stripes . . . . *Daphnis placida placida*

7. Dorsal shield (immediately behind head) as a distinct sclerotised plate, slightly raised, clearly visible to naked eye and coarsely granulated with short blunt spine-like tubercles that are clearly vivible to naked eye; thoracic segments smooth, without tubercles . . *Cephonodes picus picus*
— Not with above combination of characters 8

8. Large larva (up to 90 mm long); always greenish in colour (never brown or black) with whitish oblique lateral stripes on abdominal segments; caudal horn coarsely granulated by spine-like tubercles, some much larger than others and clearly visible to naked eye . . . . *Psilogramma menephron menephron*
— Small larva (up to 45 mm); either green, brown or black and always without oblique lateral stripes on abdominal segments; caudal horn finely granulated to naked eye, the tubercles all of similar size . . . . *Macroglossum prometheus prometheus*

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A NEW SPECIES OF *LIODROSOPHILA* DUDA (DIPTERA: DROSOPHILIDAE)

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Abstract

Liodrosophila macera sp. nov. is described from north Queensland.

Introduction

The genus *Liodrosophila* Duda contains about 50 species, largely of Oriental and Australian (New Guinea, north Queensland) distribution. The species are typically small dark flies with metallic colorations on the front and mesonotum; the scutellum is typically velvety black. A full diagnosis is given in Bock (1982), with notes on the five known Australian species.

A single specimen recently received from the Australian National Insect Collection (ANIC), C.S.I.R.O. Division of Entomology, Canberra, represents a species hitherto unknown from Australia and not referable to any other described species. The specimen is missing a few macrochaetae, but is very distinctive and easily separable from other known species. It is described below in the form used previously for Australian Drosophilidae (Bock 1982).

Liodrosophila macera n. sp.

Type.–Holotype ♀, 15: 17S 145: 13E 1 km N of Rounded Hill, Qld. (south road side track), 7.x.1980, D. H. Colless (ANIC).

Distinguishing features.–Arista fan-like; body slender; wing with pattern of pale spots against darker background; head and thorax with reduced setation as described below.

Body length.–2.5 mm.

Head.–Arista very large, with 7 long apically curved rays above and 2 straight rays below plus small terminal fork, rays long basally progressively shortening apically. Front 1.3 times broader than long, glassy blackish brown with metallic tinge (except for dull narrow band on each side characteristic of genus), smoothly rounded on to occiput. 2nd and 3rd antennal segments dusky. Carina very prominent, rather noselike but almost squared at lateral and ventral margins. Face glassy. Palp small, dusky tan, with apical bristle. Cheek linear. Eye with trace only of fine pile; greatest diameter of eye oblique. Single orbital bristle only present, slightly reclinate. Ocellar bristles large. Postverticals absent. Single vertical bristle only present.

Thorax.–Mesonotum blackish brown, glassy with metallic tinge, very finely punctate, with patch of very fine whitish scales posteriorly between dorso-central bristles tapering anteriorly towards mid-line. Two weak rows of acrostichal hairs present in extended lines of single pair of large dorsocentral bristles. Scutellum velvety black; posterior bristles broken off but clearly large; anterior scutellars very short and fine, almost vestigial, close to posterior

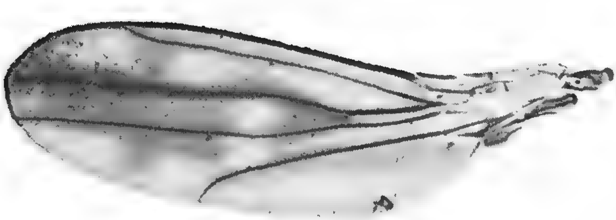

Fig. 1. *L. macera*, wing.

bristles. Pleura glassy blackish brown with strong violet metallic tinge, with single large sternopleural bristle. Haltere pale tan with anterior darkening. Legs largely pale tan, darker apically on femora and on tibiae; fore-femur darker brown; fore-tibia almost black.

Wing. (Fig. 1)–Slender, weakly brownish with pattern of pale spots, especially 3 large spots between 2nd and 3rd longitudinal veins, single spot between 3rd and 4th veins at level of posterior crossvein, and adjacent spot about latter. Anal vein absent. C-index 2.3; 4V-index 2.5; 5X-index 1.9; M-index 0.6. Heavy setation on costa weak, on 3rd costal section on basal *ca* 0.5. Length 2.0 mm.

Abdomen.–Tergite 1 tan anteriorly, black posteriorly. Remainder of abdomen shiny black.

Female genitalia.–Egg guide strong, apically pointed with a few small teeth.

Relationships.–This species most closely resembles *L. formiciformes* Bock, also known from north Queensland, especially in possessing a fan-like arista, a large carina, similar body (including eye) with wing shapes, and similar coloration (although the fore-leg in *formiciformes* is paler). *L. macera* differs from *formiciformes* in possessing a smooth front and face, only 1 pair of dorsocentral bristles, large ocellar bristles and a patterned wing (front and face finely punctate, 2 pairs of dorsocentral bristles, minute ocellars and clear wing in *formiciformes*). There seems little doubt that the two species are closely related.

Acknowledgements

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NOTES ON A COLLECTION OF BUTTERFLIES FROM THE ISLANDS OF THE GREAT BARRIER REEF, QUEENSLAND

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The published records of butterflies from the Great Barrier Reef islands are scattered. Lists have been compiled for Hinchinbrook Island (Reeves, 1978), North-West Island (Musgrave, 1926; Reeves, 1969), Heron Island (Chadwick, 1963; Fletcher, 1973), Erskine Island (Reeves, 1971), Masthead Island (Turner, 1934; Hacker, 1975) and Hoskyn Island (Reeves, 1973). Casual records can be found in Banfield (1908; 1911), Barrett & Burns (1951), Borch (1926), Butcher (1937), Carpenter (1953), Common & Waterhouse (1981), Heatwold *et al.* (1981), McNeill (1937), Peters (1969), Reeves (1979), Smithers (1983), Stephenson, Stephenson and Tandy (1931), Waterhouse (1932, 1934) and Waterhouse and Lyell (1914). From 1978-1984, one of us (J.M.) collected butterflies from a number of Great Barrier Reef islands including several for which there are apparently no records. These records are summarized in Tables 1 and 2 together with a listing of those species previously recorded.

The northern-most island on which McLean made his collections was Lizard Island, north of Cooktown. South of Lizard Island, at least one island from most of the island groups has been sampled. Islands were sometimes visited more than once but seasonal samplings were not undertaken. The southern-most island collected was Lady Musgrave Island.

In Tables 1 and 2, islands are listed in geographical groupings from north to south. The species are named and the list arranged systematically as in Common and Waterhouse (1981). Butterflies have been recorded from Great Barrier Reef islands as far north as Stanley Island in the Flinders Group, NW of Cape Melville. The islands of Torres Strait are not included in this paper. No differentiation has been made between continental and coral cay islands. The ecology of the different island types would have to be fully studied in terms of host plant availability. This has not been undertaken at the present time.

All specimens taken by McLean are housed in the Australian Museum.

It is hoped that this paper will encourage and assist other collectors to publish their records from these and other islands to help fill the gaps in our knowledge of island faunas.

Acknowledgement

We thank Dr C. N. Smithers and Mr M. S. Moulds for support and help in the preparation of this paper.

TABLE 1

Records from islands north of 21°S latitude. The butterfly list is a complete listing of all Barrier Reef species.

	Flinders Group (W of Cape Melville)	* Stanley Is. (14:09, 144:15)	* Flinders Is. (14:20, 144: 17)	North of Cooktown	* Lizard Is. (14:40, 145:28)	Rocky Is. (14:51, 145:29)	Two Isles (15:02, 145:29)	Three Isles (15:07, 145:26)	Cooktown to Innisfail	Hope Is. (15:44, 145:27)	Snapper Is. (16:18, 145:30)	* Frankland Is (17:11, 146:04)	Family Group (off Tully)	* Dunk Is. (17:55, 146:10)	† Bedarra Is. (18:01, 146:09)	Coombe Is. (18:02, 146:10)	North of Ingham	North Brook Is. (18:09, 146:17)	Goold Is. (18:10, 146:10)	* Hinchinbrook Is. (18:20, 146:17)	Off Townsville	* Great Palm Is. (18:45, 146:37)	* Magnetic Is. (19:08, 146:50)	Off Bowen	* Holbourne Is. (19:44, 148:22)	Stone Is. (20:02, 148:17)	Olden Is. (20:06, 148:34)	Whitsunday Group	* Hayman Is. (20:03, 148:53)	* Hook Is. (20:07, 148:55)	* Whitsunday Is. (20:15, 149:00)	* Haslewood Is. (20:17, 149:05)	Lindeman Group	Lindeman Is. (20:27, 149:02)	Shaw Is. (20:29, 149:05)	Off Mackay	Brampton Is. (20:49, 149:18)	St. Bees Is. (20:55, 149:18)
Badamia exclamationis																		x													x							
Tagiades japetus janetta																															x							
Trapezites petalia																																						
Proeidosa polysema		o	o																																			
Taractrocera ina																													o									
Ocybadistes flavovittatus flavovittatus																																						
Ocybadistes walkeri sonia																																						
Telicota ancilla ancilla																						o																
Graphium sarpedon choredon																				x																		
Papilio anactus																																						
Papilio demoleus sthenelus																										x												
Papilio ulysses joesa														o						o																		
Cressida cressida cressida														x					x				o								x			x			x	x
Pachliopta polydorus queenslandicus																				x																		
Ornithoptera priamus euphorion														o						o			o															
Catopsilia pomona pomona																																						
Catopsilia gorgophone gorgophone																																						
Eurema hecabe phoebus					x					x										o														x	x		x	
Eurema smilax																											x							x				
Elodina parthia																																						
Elodina angulipennis																																						
Elodina padusa																																						
Elodina perdita perdita						x	x																		o		x		o						x			
Delias argenthona argenthona																				o																		
Delias mysis mysis														x		x				o																		
Delias aganippe																																						
Anaphaeis java teutonia																																						
Cepora perimale						x	x	x		x																	x				x				x			
Appias paulina ega						x																									x							
Pieris rapae rapae																																						
Danaus plexippus plexippus																				o																	x	
Danaus chrysippus petilia															x					o											x				x			
Danaus affinis affinis																																						

Danaus hamatus hamatus	x				x							o	o		o	o	●	o		x	x	x
Euploea core corinna	o											o								x	x	
Euploea sylvester sylvester																	x					
Euploea tulliolus tulliolus							o					o	o				x			x		x
Tellervo zoilus gelo						x																
Melanitis leda bankia									x			o		x					x	x	x	
Mycalesis sirius sirius														x					x			
Mycalesis terminus terminus						x		x	x													
Hypocysta irius											x	●										
Hypocysta metirius																						
Hypocysta adiante adiante	x										x	o							x	x		
Heteronympha merope merope																						
Xois arctoa arctoa											x									x	x	
Polyura pyrrhus sempronius												o										
Pantoporia consimilis consimilis																	x					
Hypolimnas bolina nerina	x	x	x					o									x		x			
Hypolimnas misippus																						
Hypolimnas alimena lamina												o										
Vanessa kershawi																			x			
Junonia villida calybe			x											x								
Junonia orithya albicincta														x								
Cethosia cydippe chrysippe								o														
Cupha prosope prosope								x				o					x					x
Acraea andromacha andromacha										x		o		x					x			
Libythea geoffroy nicevillei													o									
Hypochrysops apelles apelles																						
Arhopala madytus																	x					
Hypolycaena phorbas phorbas	x		x														x					
Anthene seltuttus affinis	x			x																		
Candalides erinus erinus	x	x	x	x	x			x						x					x	x	x	
Candalides acastus																						
Nacaduba kurava parma																						
Nacaduba biocellata biocellata												o										
Prosotas dubiosa dubiosa												o										
Catopyrops florinda halys																						
Catopyrops florinda estrella																						
Theclinesthes onycha onycha																						
Theclinesthes sulpitius																						
Theclinesthes sp.	x																x					
Danis danis serapis												x										
Danis cyanea arinia								x														
Lampides boeticus												o										
Syntarucus plinius pseudocassius																						
Zizeeria karsandra					x																	
Zizina labradus labradus			x		x			x				o							x			
Famegana alsulus alsulus	x				x	x																
Euchrysops cnejus cnidus	x										x	o										

* Previously recorded islands
† Also called Richard Island
x Mclean records
o Previous records
● Mclean and previous records

TABLE 2

Records from islands south of 21°S latitude. The butterfly list is a complete listing of all Barrier Reef species.

	Percy Isles (off Sarina)		Duke Islands	Keppel Is. Group		Off Rockhampton	Capricorn Group (off Rockhampton)								Off Gladstone					Bunker Group		
	* Percy Is. (21:42, 150:20)	Middle Percy Is. (21:40, 150:20)	* Low Isle (22:03, 150:06)	Great Keppel Is. (23:10, 150:58)	Barren Is. (23:10, 151:05)	Hummocky Is. (23:24, 151:09)	* Tryon Is. (23:15, 151:46)	* North West Is. (23:18, 151:42)	Wilson Is. (23:18, 151:55)	Wreck Is. (23:20, 151:57)	* Heron Is. (23:26, 151:55)	* Erskine Is. (23:30, 151:46)	* One Tree Is. (23:30, 152:05)	* Masthead Is. (23:32, 151:43)	Curtis Is. (23:38, 151:10)	Garden Is. (23:47, 151:14)	Compigne Is. (23:47, 151:16)	Wiggins Is. (23:49, 151:13)	Facing Is. (23:49, 151:22)	* Hoskyn Is. (23:48, 152:18)	Fairfax Is. (23:51, 152:23)	Lady Musgrave Is. (23:54, 152:23)
Badamia exclamationis																						
Tagiades japetus janetta																						
Trapezites petalia																	x					
Proeidosa polysema																						
Taractrocera ina																						
Ocybadistes flavovittatus flavovittatus								■						o								
Ocybadistes walkeri sonia							o	o				o		x						o		
Telicota ancilla ancilla																						
Graphium sarpedon choredon																						
Papilio anactus																x						
Papilio demoleus sthenelus																						
Papilio ulysses joesa																						
Cressida cressida cressida	x																x	x				
Pachliopta polydorus queenslandicus																						
Ornithoptera priamus euphorion			o																			
Catopsilia pomona pomona		x									o			x	x						x	
Catopsilia gorgophone gorgophone														o								
Eurema hecabe phoebus	x					x		o			o					x	x	x		o		
Eurema smilax								o														
Elodina parthia	x							o														
Elodina angulipennis	x															x						
Elodina padusa								o														
Elodina perdita perdita																						
Delias argenthona argenthona																x						
Delias mysis mysis																						
Delias aganippe												o										
Anaphaeis java teutonia				x				o			o	o				x	x	x	x			
Cepora perimale		x				x																
Appias paulina ega		x			x			●			x					x			x			x
Pieris rapae rapae												o										
Danaus plexippus plexippus											o		o					x				
Danaus chrysippus petilia		x									o								x			
Danaus affinis affinis															x			x				

Danaus hamatus hamatus	x	x	o	x	x	x		●		x	o			●	x	x		x		o	x	
Euploea core corinna	x			x				o			o					x	x	x	x			
Euploea sylvester sylvester																						
Euploea tulliolus tulliolus	x	x						o		x	o				x							
Tellervo zoilus gelo																						
Melanitis leda bankia	x			x				●		x	●			x	x	x				o		
Mycalesis sirius sirius																						
Mycalesis terminus terminus																						
Hypocysta irius																						
Hypocysta metirius																						
Hypocysta adiante adiante	x	x		x												x	x					
Heteronympha merope merope	o																					
Xois arctoa arctoa		x		x															x			
Polyura pyrrhus sempronius								o														
Pantoporia consimilis consimilis																						
Hypolimnas bolina nerina								●	x		●		o	o						●	x	x
Hypolimnas misippus																x						
Hypolimnas alimena lamina																						
Vanessa kershawi	o							o										x				
Junonia villida calybe				x				o						x		x	x		x			
Junonia orithya albicincta																						
Cethosia cydippe chrysippe																						
Cupha prosope prosope				x																		
Acraea andromacha andromacha	x							o			o					x	x					
Libythea geoffroy nicevillei																						
Hypochrysops apelles apelles																	x					
Arhopala madytus																						
Hypolycaena phorbas phorbas		x																				
Anthene seltuttus affinis																						
Candalides erinus erinus		x		x				o			●	o				x						
Candalides acastus																						
Nacaduba kurava parma								o														
Nacaduba biocellata biocellata								o			o											
Prosotas dubiosa dubiosa																						
Catopyrops florinda halys														o								
Catopyrops florinda estrella								o						o						o		
Theclinesthes onycha onycha												o										
Theclinesthes sulpitius																x						
Theclinesthes sp.		x																				
Danis danis serapis																						
Danis cyanea arinia																						
Lampides boeticus								o			o	o					x					
Syntarucus plinius pseudocassius								o					●							o		
Zizeeria karsandra							x	●		x		o										
Zizina labradus labradus		x						o			o					x						
Famegana alsulus alsulus																	x					
Euchrysops cnejus cnidus																						

* Previously recorded islands
x Mclean records
o Previous records
● Mclean and previous records

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NEW SPECIES NAMES IN TIPULIDAE (DIPTERA).

By Pjotr Oosterbroek
Institute of Taxonomic Zoology (Zoölogical Museum), University of Amsterdam, Platage Middenlaan 64, 1018 DH Amsterdam 1004, Netherlands

Abstract

Five new names for species of Tipulidae, one in *Tipula*, one in *Nephrotoma*, and three in *Limonia*, are proposed to replace preoccupied names.

In preparing the Tipulidae part for the Catalogue of the Australian/Oceanian Diptera, to be published by the Bernice P. Bishop Museum, Honolulu, a number of species names turned out to be preoccupied. The new names proposed for these species are as follows:

Tipula vanewrighti **nom. nov.** for *Tipula lateralis* Walker, 1848: 70, preoccupied by Meigen, 1818: 174.

Named after Richard I. Vane-Wright in honour of his work on *Holorusia* and related genera (Vane-Wright, 1967). This north-west Australian species was assigned to *Holorusia* by Vane-Wright, but was provisionally placed in *Tipula (Acutipula)* by Dobrotworsky, 1974.

Nephrotoma walkeri **nom. nov.** for *Pachyrrhina tenuis* Walker, 1865: 106, preoccupied by Loew, 1863: 297.

The highest number of insect species, described by one man, Francis Walker, is about 20,000. Large numbers of insect species were described as well by Maurice Pic (*c.* 15,000), Edward Meyrick (*c.* 15,000), Charles P. Alexander (*c.* 11,000), Edmund Reiter (*c.* 10,000), Johann C. Fabricius (9-10,000) and Thomas L. Casey (9-10,000).

Limonia (Dicranomyia) pictithorax ssp. *veenmani* **nom. nov.** for *Dicranomyia pictithorax* ssp. *argentifera* Alexander, 1924: 565, preoccupied by de Meijere, 1911: 29.

Named after the Veenman word processor on which the Tipulidae part for the above mentioned catalogue was written.

Limonia (Discobola) milleri **nom. nov.** for *Tipula fumipennis* Hudson, 1892: 48, preoccupied by Butler, 1875: 355.

Named after David Miller for his work on New Zealand entomology.

Limonia (Libnotes) subfasciatula **nom. nov.** for *Libnotes subfasciata* Edwards, 1926: 137, preoccupied by Alexander, 1924: 563.

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BOOK REVIEW

Biological Control in Agricultural IPM Systems edited by Marjorie A. Hoy and Donald C. Herzog. Pub. August, 1985. 589 pages, case bound. Academic Press, Florida and London. Price US$49.50.

Ever since the spectacular early successes of classical biological control of insect pests and weeds the approach of augmenting or conserving natural enemies in agricultural systems has been enthusiastically researched as a component of integrated pest management (IPM) systems.

This book arose out of a symposium of the same name held at the Citrus Research and Education Centre, University of Florida, June 4-6, 1984. Its aim was not simply to discuss aspects of biological control but in the words of the editors to "scrutinise very carefully the current status of biological control in our agricultural IPM systems . . .". The book is thus not simply a compendium of biological control research but attempts to determine why, despite being viewed as a cornerstone of IPM, research on biological control has so rarely been implemented.

In its 31 chapters the book provides an extensive overview of the current state of biological control of arthropods, weeds, nematodes and plant pathogens in IPM systems and of research techniques applicable to many aspects of the field. After a general introduction (4 chapters) covering historical aspects of biological control, the current status of IPM in agriculture and cost-benefit analyses, there are sections on biological control of arthropods (14 chapters), weeds (2 chapters), plant pathogens (4 chapters) and nematodes (1 chapter). Finally the current status and limits to biological control are examined in five representative cropping systems; citrus, vineyards, alfalfa, cotton and soybean. Despite this multitude of chapters and authors, the editors have done an excellent job in limiting overlap in subject matter. Topics covered include: the interaction of biological control with resistant crop varieties and selective pesticides; improved establishment, recognition of biotypes and genetic improvement of natural enemies; estimating the abundance and impact of natural enemies and their incorporation into crop/pest models. In addition some chapters provide critical analyses of current systems based on augmentation of predators and parasites and cost-benefit analyses of IPM and biological control programs in general. As well as providing comprehensive reviews of particular areas each chapter lists specific recommendations for future research, development and implementation of biological control systems.

Although the chapters are too numerous to summarise individually some highlights are an historical account by Huffaker in which he laments that "far more has been said about the *possibilities* than about proven, large-scale *commercial utilization*" of biological control systems. Herzog and Funderbunk provide an interesting discussion of interaction between biological control and other elements of IPM systems such as resistant plant cultivars and cultural practices. They point out that augmentation of natural enemies may not always be compatible with strategies which alter the physical or

chemical properties of the crop plant. King *et al.* provide a thorough and critical analysis of 8 systems based on the augmentation of predators and parasites. They demonstrate that despite technical feasability, the economics of augmentative releases are rarely addressed and often prove unacceptable relative to alternative systems based on pesticides.

Overall the book provides a useful coverage of current research directions but also emphasises the need for future funding, research and most importantly implementation of biological control as a component of IPM systems. Although dealing exclusively with US systems, the approaches and literature reviews should be of value to many workers in this field and to entomologists with a general interest in pest dynamics and control.

G. P. FITT

AN ACCUMULATIVE BIBLIOGRAPHY OF AUSTRALIAN ENTOMOLOGY

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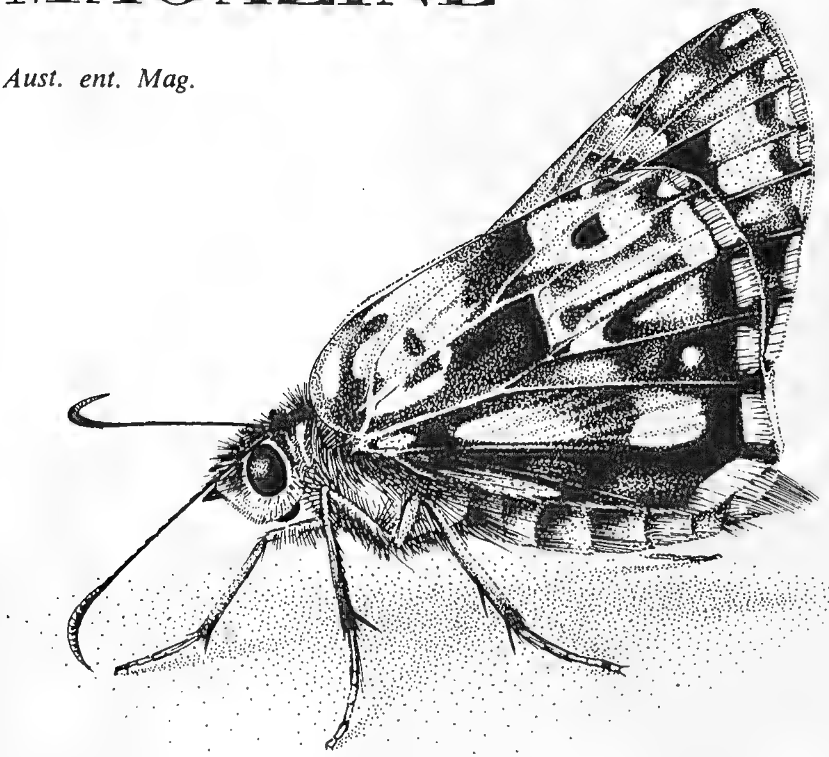

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COVER

Illustrated by Andrew Atkins

Hesperilla mastersi mastersi Waterhouse, 1900 (♀). This handsome skipper is distributed from southern Queensland to eastern Victoria, where it is restricted to temperate and subtropical rainforests and dense coastal thickets on cliff slopes. Adults fly from September to March but probably only have one generation each year. The semi-spherical eggs are laid singly beneath young leaves of the foodplant, *Gahnia melanocarpa* that grows in dark gullies. The brightly striped larvae and elongate pupae are found in tube-shaped leaf shelters within the foodplant and attached debris.

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THE LIFE HISTORY OF *TRAPEZITES IACCHOIDES* WATERHOUSE AND *TRAPEZITES PHIGALIOIDES* WATERHOUSE (LEPIDOPTERA: HESPERIIDAE: TRAPEZITINAE)

By Andrew Atkins

45 Caldwell Avenue, Dudley, New South Wales 2290

Abstract

The early stages of *Trapezites iacchoides* Waterhouse and *Trapezites phigalioides* Waterhouse are described and illustrated. The skippers are briefly compared with other closely related species of *Trapezites.*

Introduction

Trapezites iacchoides Waterhouse (Figs 12, 13) and *Trapezites phigalioides* Waterhouse (Figs 27, 28) are found in the cool-temperate *Eucalyptus* woodlands of the Great Dividing Range of eastern Australia, from the New South Wales/Queensland border to Victoria. The species are generally montane butterflies in the northern part of their range. Both are univoltine, the adults flying from September to January.

The mature larva and pupa of *T. phigalioides* were described by Common and Waterhouse (1981) and the life history of *T. iacchoides* was previously unknown.

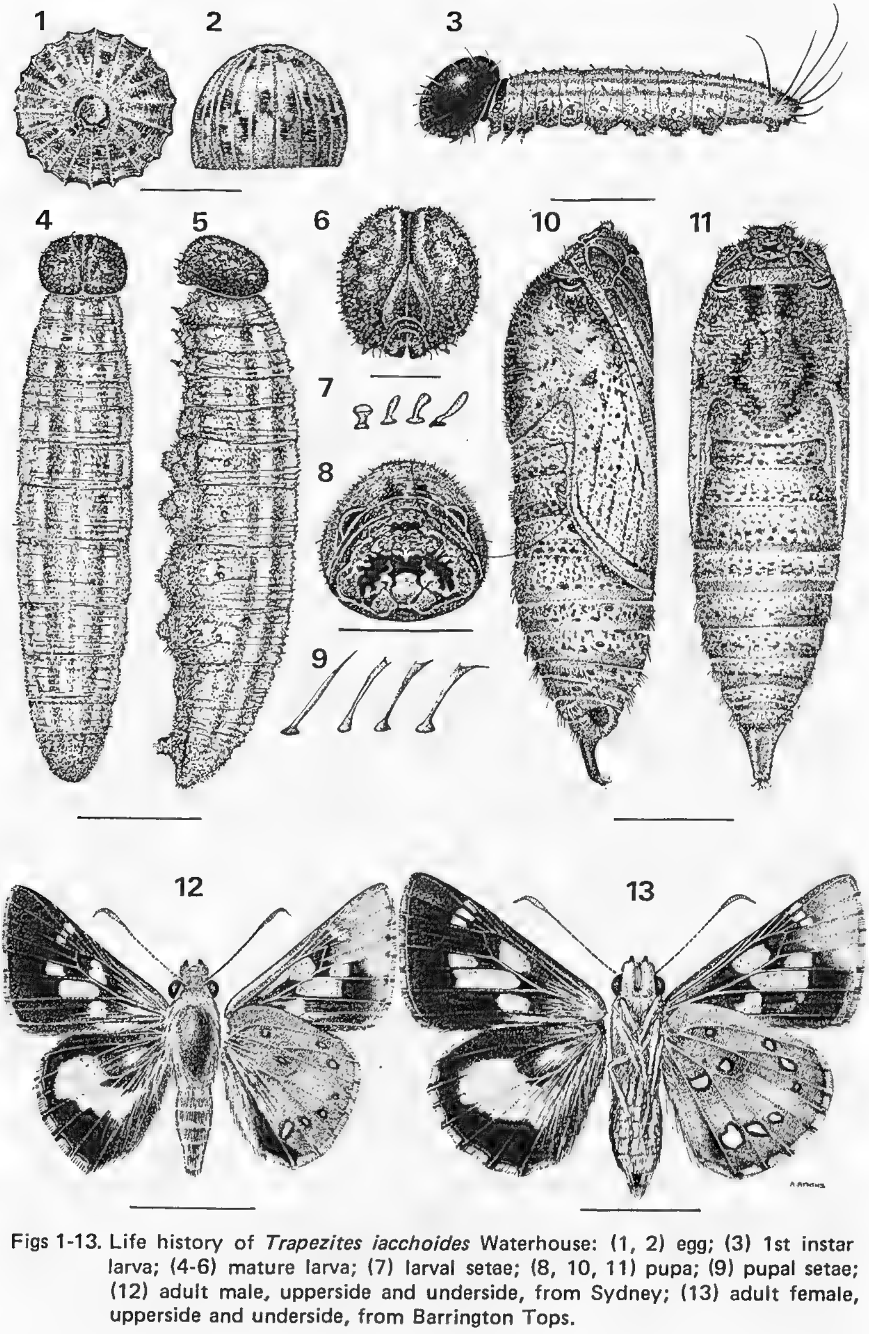
Trapezites iacchoides Waterhouse, 1903.

(Figs 1-15)

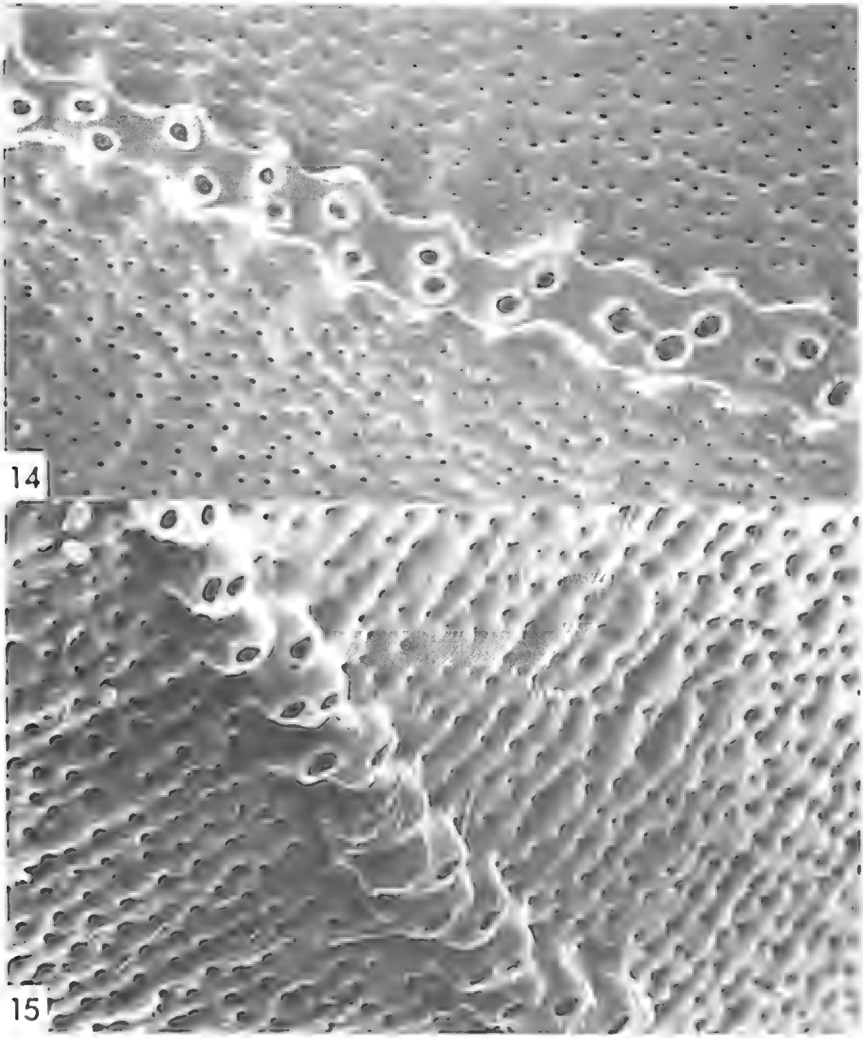
Foodplant. Lomandra sp., family Xanthorrhoeaceae.

Egg. (Figs 1, 2, 14, 15). Diam. 1.4 mm, dome-shaped, pale green when first laid, changing in 2 days to cream coloured with orange-brown dorsal and lateral markings; 19-21 prominent vertical ribs.

Larva. (Figs 3-7). *1st instar* (Fig. 3): length 3.5 mm; head shiny black, pale setae on frons and dorsal area; prothoracic plate black; body pale straw-coloured with orange-brown dorsal and dorso-lateral lines; long pale setae on posterior segments. *2nd-5th instars* (4th instar Figs 4-7): head dark brown with several light brown spots and 2 elongated pale patches extending dorsally to frons; body pale grey-green to brown with darker mottling forming a dorsal and 2 dorso-lateral lines along length of body; body setae short and clubbed (Fig. 7).



Figs 1-13. Life history of *Trapezites iacchoides* Waterhouse: (1, 2) egg; (3) 1st instar larva; (4-6) mature larva; (7) larval setae; (8, 10, 11) pupa; (9) pupal setae; (12) adult male, upperside and underside, from Sydney; (13) adult female, upperside and underside, from Barrington Tops.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Figs 14, 15. SEM photograph of egg detail: (14) *Trapezites iacchoides* egg from Sydney; (15) *Trapezites iacchoides* egg from Barrington Tops. Magnification x500.

Pupa. (Figs 8-11). Length 24 mm; pale brown with darker brown spots covering abdominal segments; cremaster dark brown; thorax covered with dark brown spots with 2 roughly crescent-shaped dark markings at posterior and wedge-shaped dark markings at anterior edge; wing-cases marked with dark brown spots along wing venation; pupal cap sclerotized with a short, bifid projection and covered in waxy 'bloom' which variably extends posteriorly to wing-cases, thorax and abdominal segments; pupal setae (Fig. 9) simple to 'fish-tailed' and covering body, especially on posterior segments.

Trapezites phigalioides Waterhouse, 1903.
(Figs 16-28)

Foodplant. Lomandra sp., family Xanthorrhoeaceae.

Egg. (Figs 16, 17). Diam. 1.2 mm, dome-shaped, pale green when first laid, orange pattern less prominent than that of *T. iacchoides*; 18-20 ribs.

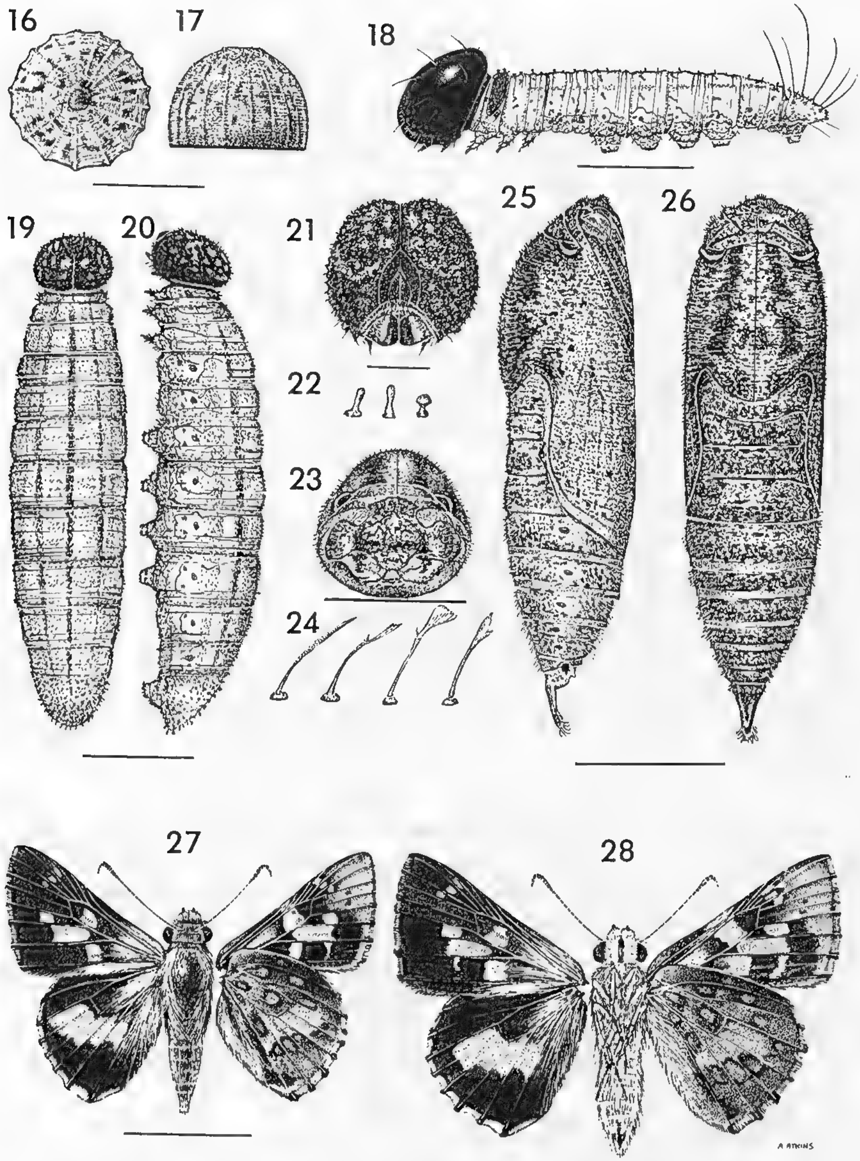
Larva. (Figs 18-22). *1st instar* (Fig. 18): length 3 mm, similar to *T. iacchoides. 2nd-5th instars* (4th instar, Figs 19-22) similar to *T. iacchoides*; head covered (mainly dorsal area) with irregular pale brown spots; body with a dorsal and dorso-lateral dark line (mature larva described by Common and Waterhouse, 1981).

Pupa. (Figs 23-26). Length 20 mm; pale brown with darker brown spots; cremaster dark brown; thorax with wedge-shaped dark markings at anterior edge and two dorso-lateral dark brown bands, narrow centrally; wing-cases and waxy 'bloom' similar to that of *T. iacchoides*; pupal setae (Fig. 24) simple.

Notes

Field observations of *Trapezites iacchoides* were made at Sydney and Barrington Tops, New South Wales, and those of *Trapezites phigalioides* at Honeysuckle Creek, Australian Capital Territory. Eggs were obtained by caging adult females from these localities in net-covered pots containing various species of *Lomandra.* The eggs were laid at random on the leaves, debris and netting and hatched within 16 days. The larvae readily accepted *Lomandra filiformis* (Thunb.), *Lomandra glauca* (R. Br) Ewart, *Lomandra multiflora* (R. Br) Britten and *Lomandra longifolia* Labill. The larvae fed regularly at night during late summer and autumn, but less frequently during cold weather in winter. The larvae rested during the day in silk-woven shelters within the foodplant, and the later instars made shelters of debris, densly lined with silk, at the base of the plant where pupation occured. The pupal stage lasted approximatelv 2 weeks. Males tended to emerge earlier in the season than females.

The adults of both species are active in bright warm weather, flying swiftly and low across sunlit glades. They frequent the flowers of *Pimelia* spp. and wild raspberry. Males normally 'hill-top' but at Barrington Tops both males and females of *T. iacchoides* rest, during warm cloudy weather, on stones and road-tracks. Oviposition of this species was not recorded, though females at Sydney were seen to flutter around *L. glauca.* A female of *T. phigalioides* was observed ovipositing on an unidentified *Lomandra* seedling at Honeysuckle Creek. Common and Waterhouse (1981) record *L. filiformis* as the larval foodplant of this species at the Boyd River, New South Wales.



Figs 16-28. Life history of *Trapezites phigalioides* Waterhouse: (16, 17) egg; (18) 1st instar larva; (19-21) mature larva; (22) larval setae; (23, 25, 26) pupa; (24) pupal setae; (27, 28) adult male and female, upperside and underside, from Honeysuckle Creek.

Comments

The life histories of *Trapezities iacchoides* and *Trapezites phigalioides* are typical for this genus and very similar to those of *Trapezites maheta* (Hewitson) and *Trapezites praxedes* (Plotz). These four species were originally considered to be a single species (see Waterhouse, 1912 and Sands *et. al.*, 1984). Comparison of both adult and juvenile morphology and habitats of these skippers indicate that they comprise a distinctive species group within the genus, with *Trapezites phigalia* (Hewitson) their closest ally.

T. maheta and *T. praxedes* are confined to northern and southern coastal or near-coastal sclerophyll forests of eastern Australia at elevations below 500 m. Both are bivoltine. *T. iacchoides* and *T. phigalioides* are single-brooded, and are more common at an elevation from 300 m to 1400 m and are generally very local in occurrence. In some localities both species are found together, but *T. iacchoides* appears to prefer higher rainfall zones on hill-slopes or near elevated swamps.

Variation

There are significant differences in the early stages of *Trapezites iacchoides* from Sydney and those from Barrington Tops. These differences can be seen in the rib-structure of the eggs (Figs 14, 15). The larval head and pupa of specimens reared from Sydney are more strongly marked and the adults from montane northern New South Wales are larger and more brightly patterned. Similarly, adults of *T. phigalioides* from northern New South Wales and southern Queensland are larger than specimens from southern New South Wales, the Australian Capital Territory and eastern and western Victoria.

Acknowledgements

I am grateful to Mr M. S. Moulds and Mr G. Daniels for field assistance at Sydney and to Mr G. Weber, University of Newcastle for the Scanning Electron Microscope photographs.

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NOTES ON THE BEHAVIOUR AND NESTS OF AN AUSTRALIAN MASARID WASP *PARAGIA (PARAGIA) DECIPIENS DECIPIENS* SHUCKARD (HYMENOPTERA: VESPOIDEA: MASARIDAE)

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Abstract

Females of *P. decipiens* excavated turretless nests in hard clay at Fowlers Gap in arid, western New South Wales. Females alighted on water surfaces and imbibed water for use in softening the nest substrate. Nests were provisioned with pollen of *Eucalyptus camaldulensis.* Males were attracted to nest entrances, water and honeydew.

Introduction

As far as is known, most non-Australian species of masarid wasps are like solitary bees in that they provision their nests with pollen and nectar (Richards, 1962; Gess and Gess, 1980). Species of only one of the masarid subfamilies, the Nearctic Euparagiinae, are predatory (Clement and Grissell, 1968) as are all other Vespoidea. Carpenter (1982) has argued that the Masaridae *sensu* Richards (1962) is a paraphyletic group, and that the Euparagiinae is the sister-group to all other vespoids.

All Australian species of Masaridae belong in the subfamily Masarinae (*sensu* Richards, 1962) and most are poorly known biologically. Wilson (1869) observed females of *Paragia (Paragia) smithii* Saussure entering turreted burrows in the ground, and Richards (1968) noted flower-visiting by two species of *Riekia* Richards, but the only detailed descriptions of nesting sites and nest structures are those of Houston (1984), for *Paragia (Paragia) tricolor* Smith.

Although rarely collected, masarids can be locally abundant, particularly around pools of water in otherwise arid regions. Such a congregation of masarids was drawn to our attention in 1981 by Dr J. M. E. Anderson, of the University of New South Wales, who had collected large numbers of four species of *Paragia* [*P. (Paragia) decipiens decipiens* Shuckard, *P. smithii, P. (Paragiella) odyneroides* Smith, and an undescribed species] at Fowlers Gap Arid Zone Research Station in western New South Wales. Our observations on the first of these species (referred to below as *P. decipiens*) were made at Fowlers Gap during 1981 and 1982, and complement Houston's (1984) account of *P. (P.) tricolor. P. decipiens* is a medium sized masarid (body length 12-17 mm), with known distribution as shown in Fig. 4.

Study site

Observations were made at the headquarters of the Fowlers Gap Arid Zone Research Station (31°05′S, 141°42′E), approximately 100 km NNE of Broken Hill. The Station has an average annual rainfall of 240 mm, which is evenly distributed throughout the year. Rainfall is unreliable and often occurs as brief showers which do not moisten the soil to depths below 6 mm (see Specht, 1972). November-March temperatures generally fluctuate between 12-22° (daily minimum) and 30-40°C (daily maximum); whereas May-September temperatures lie between 2-9°C and 17-28°C.

Fig. 1. Nesting areas (arrowed) of *P. decipiens decipiens* at Fowlers Gap, New South Wales.

Nests of *P. decipiens* were located in disturbed areas adjacent to buildings, in areas of low grass and herbs where a few species of eucalypts had been planted, and in an earth road adjacent to a creek (Fig. 1; creek flanked by a woodland formation dominated by *Eucalyptus camaldulensis* Dehnh). The study area was surrounded by treeless shrubland in which no masarid nests were discovered.

Adult wasps were observed in the above areas and around pools of the creek, a man-made earth dam, and a tiled swimming pool in the grounds of the Research Station. Observations were made during the periods 29 November-2 December, 1981, and 8-10 December 1982.

Female behaviour

Water visiting

Adult females of *P. decipiens* alighted on the surface of water in natural pools in the creek bed, in the earth dam and in the swimming pool. The relatively muddy waters of the creek bed and dam, and the clear, chlorinated water of the swimming pool appeared to be equally attractive to wasps. A few

dead wasps floated on the surface of the swimming pool but not on the surface of water in the creek bed or in the dam. Possibly these wasps were killed by the chlorinated water. On the other hand, we observed that occasionally the wings of wasps accidentally came in contact with the surface of the water and were held there. Wasps trapped in this way could neither fly nor scale the vertical, smooth, tiled walls of the pool. The banks of the creek-bed pools and dam sloped gradually and we observed that wasps which were trapped temporarily by surface tension would eventually drift to these banks, gain a footing and escape.

Water surfaces were frequented by four species of Masaridae (see list above) and several species of Eumenidae and Sphecidae. All masarids and eumenids drank with the body horizontal, with their tarsi and at least part of the metasoma in contact with the water. Sphecids drank with the long body axis at least 30°above the horizontal.

On taking off after drinking, adults of *P. decipiens* sometimes dragged the apex of the metasoma in the water for a horizontal distance of 10-20 cm. Presumably, *P. decipiens* carries water in the crop, as do other vespoid wasps. Adults of *P. decipiens* frequented water from about 10 am to about 3 pm.

Nest excavation

The following notes are based on interrupted observations of one female in 1981. An excavation cycle consisted of:–

(i) An absence from the nest of 55-120 seconds (average 89 seconds, n = 9). The female left the nest and flew towards the earth dam and presumably imbibed water there. Several brief absences (up to 20 seconds) were also observed. These might have been short orientation flights in the immediate vicinity of the nest. Several longer absences (more than 13 minutes) were not explained.

(ii) 2-5 intervals, each of 15-62 seconds (average 34 seconds, n = 48) spent underground. A mud pellet was discarded from the nest at the end of each of these intervals. Presumably the female regurgitated water from the crop to soften the hard clay. Mud pellets were discarded in two different ways:–
   (a) the female emerged from the nest, flew 15-30 cm from its entrance, dropped the pellet, and returned to the nest (total duration: 1-2 seconds);
   (b) the female dropped the pellet 1.0-1.5 m from the nest entrance as it flew off towards the dam, thus completing an excavation cycle.

Pollen collection

Adult females were collected at flowers of *E. camaldulensis* but not at flowers of another unidentified species of *Eucalyptus* or those of small shrubs in the vicinity. Pollen in the only larval food mass removed from a nest was of the one type and microscopically matched pollen sampled from *E. camaldulensis.* Pollen was carried in the crop of the female and, judging from

the size of the crop and the size of the larval food mass, several provisioning journeys would have been necessary to build up the pollen mass.

Male behaviour

Males of *P. decipiens* alight on water surfaces and drink in company with females. On one occasion a male attempted to mate with a female on the ground near the swimming pool. Several males spent long periods (up to 20 minutes) on the ground watching open nest entrances.

Large numbers of males of *P. decipiens* (as well as both sexes of many other Hymenoptera) were attracted to new growth on one unidentified eucalyptus tree growing near the swimming pool. Apparently the wasps were seeking honeydew produced by cicadellid nymphs. Female masarids were not attracted in the same way.

Nests

Several short, vertical burrows (depth 4-5 cm) were located within 5 m of the swimming pool. One of these contained a dead female of *P. decipiens.*

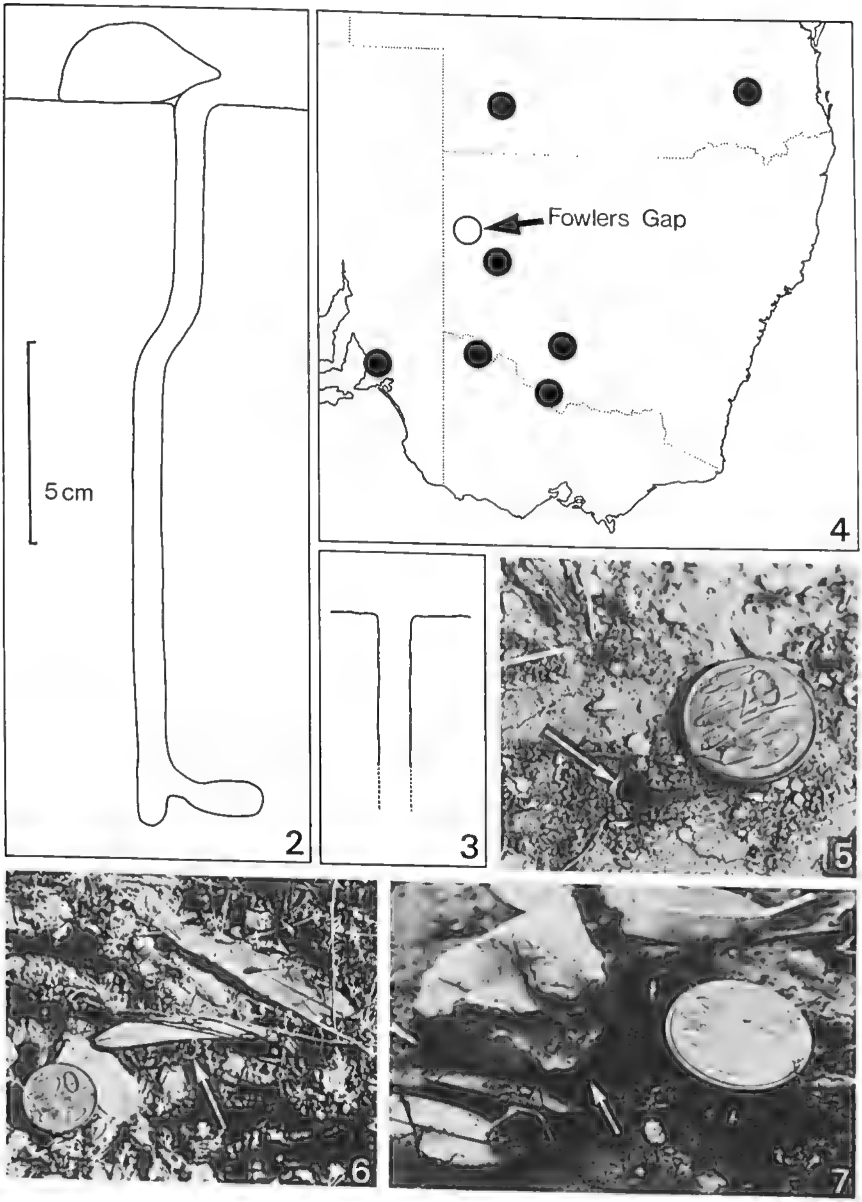
Sites of active nests were 50-300 m from water and flowering *E. camaldulensis*, in hard, compacted clay.

Five active nests were excavated. One contained a single larval cell but four had no cells. Each nest consisted of a vertical shaft, which was circular in cross-section and narrowed quickly to a diameter of 5-7 mm (Fig. 2). Four of the five shafts had a slight bend 5-10 cm below the surface. The inner surfaces of the shaft were smooth. The horizontal larval cell was connected to the vertical shaft by a very short, open access shaft. The cell (including the access shaft) was approximately 23 mm long and attained a maximum diameter of 9 mm near the rounded blind end. The walls of the cell were 1-2 mm thick, apparently of compacted clay, and large fragments could be removed from the surrounding, softer matrix. The inner surfaces of the walls were smooth and unlined. The entrances to the nests were approximately 10 mm in diameter and were either exposed (Fig. 5) or (more commonly) concealed by a leaf or rock (Figs 6, 7). Entrances were not surmounted by turrets (Fig. 3). However, where entrances were concealed beneath leaves or rocks, the shaft was extended above ground level as an incomplete, thin-walled tube (Fig. 2).

The larval food mass was a soft, yellow, moist, irregularly-shaped loaf on which the larva fed externally. The only larva collected has been preserved in the Australian National Insect Collection, CSIRO, Canberra.

Natural enemies

A species of *Anthrax* Scopoli (Diptera: Bombyliidae) and one of *Hyptiogaster* Kieffer (Hymenoptera: Gasteruptiidae) entered nests of *P. decipiens* (several observations of each) but neither was confirmed to be a parasite of *P. decipiens.* Twenty-five per cent (n = 24) of adult females and 13% (n = 54) of adult males were stylopised. Stylopised specimens have been preserved in the Australian National Insect Collection.



Figs 2-7. *P. decipiens decipiens*: (2) nest with concealed entrance and larval cell, vertical section; (3) exposed nest entrance, vertical section; (4) distribution map; (5, 6, 7) nest entrances (arrowed).

Abundance

P. decipiens was abundant at Fowlers Gap during December, 1979. Up to 150 adults were present simultaneously around the swimming pool (Anderson, pers. comm.; unpub. photographs). During our 1981 visit, 30 adults at most were present at the pool at any one time. In 1982 there were five at most.

Discussion

In alighting on the water surface to drink, *P. decipiens* behaves similarly to *P. smithii* and *P. odyneroides* (Naumann, pers. obs.) and several South African masarid species [*Ceramius capicola* Brauns, *Ceramius linearis* Klug and *Ceramius lichtensteineii* (Klug)] reported on by Gess and Gess (1980). *Jugurtia confusa* Richards, another South African masarid, stands on mud at the edge of water to drink (Gess and Gess, 1980). *C. capicola, C. lichtensteineii, J. confusa* and *P. decipiens* all have water collection intervals of about the same duration. *P. decipiens* excavates and discards each mud pellet from the nest 2-4 times more quickly than *Ceramius* spp. (Gess and Gess, 1980). *P. decipiens* disposes of pellets over a wide area, always more than 15 cm from the nest entrance, as do *C. lichtensteineii* and *J. confusa.* Presumably widely dispersed pellets do not draw the attention of parasites to nest entrances. In contrast, *C. capicola* deposits pellets in a discrete area much closer to the nest entrance. Houston (1984) did not describe water collection or pellet disposal by *P. tricolor* females.

The general structure of the nest of *P. decipiens* is similar to that of *P. tricolor* (Houston, 1984) and those of most of the investigated non-Australian, ground-nesting masarids (Gess and Gess, 1980). However, in *P. tricolor* the entrance is extended above ground level by a mud turret. Nests of two other Australian masarids, *Rolandia maculata* (Meade-Waldo) and an undescribed species of *Riekia*, also appear to be turretless (Houston, 1984), as are most nests of *J. confusa* (Gess and Gess, 1980).

Compacted, clay turrets or funnels at the entrances of wasp nests exclude at least some parasites (Smith, 1978) and, in the case of ground nests, may also exclude wind-blown surface particles. Because of their fragile construction, it is unlikely that they prevent flooding during rainstorms, which seems to be the function of turrets surmounting gryllacridid burrows in arid Australia (Morton and Rentz, 1983). The entrances to *P. decipiens* nests are usually concealed. Perhaps, concealment confers the same protection against parasites as does the turret in other species..

Nests of *P. tricolor* and non-Australian masarids are multi-celled. At Fowlers Gap, the only nest of *P. decipiens* containing a larval cell was still active, and it is possible that older nests of *P. decipiens* are multi-celled. Only one female *P. decipiens* is associated with each nest. It is not known whether nests are re-used by successive generations of wasps.

As far as is known, *P. decipiens* collects only *E. camaldulensis* pollen. *P. tricolor* only collects pollen of either *Eucalyptus calophylla* R. Br. or *Eucalyptus cylindriflora* Maiden and Blakely, and Houston (1984) correlates

seasonality in *P. tricolor* activity with flowering periods of these two trees. The larval food mass of *P. decipiens* is more soft and moist than that of *P. tricolor* and lacks regular folds and annulations.

The apparent decline in the population of *P. decipiens* from 1979 to 1982 may be correlated with very low rainfall and increasing "drought" conditions in the area. For successful nesting, *P. decipiens* requires nesting sites, water and pollen. In 1981 and 1982 at Fowlers Gap, none of these requirements appeared to be a limiting factor, the swimming pool being filled with bore water, and at least some *E. camaldulensis* being in flower. We speculate that a minimum fall and soil penetration of rain is necessary to stimulate or enable emergence of *P. decipiens* from the subterranean cells in which they have completed their larval and pupal development, and that this minimum requirement was not generally met in the months prior to our 1981 and 1982 visits.

Acknowledgements

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THE LIFE HISTORY OF *APPIAS ADA CARIA* WATERHOUSE AND LYELL (LEPIDOPTERA: PIERIDAE: PIERINAE)

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Abstract

The previously unrecorded life history of *Appias ada caria* Waterhouse and Lyell is described and a food plant listed.

Introduction

The rare albatross, *Appias ada caria* Waterhouse and Lyell, is common at times in the Iron Range area of North Queensland. Here I observed specimens to fly rapidly along watercourses and regularly examine the foliage of a trifoliolate plant. Examination of this plant, *Crateva religiosa* G. Forster, Capparaceae, revealed ova and larvae.

Life history

Ovum. Spindle shaped, vertically ribbed, height 1 mm about twice width, white, later turning orange.

First instar. Head white, smooth, shiny. Body green, finely haired, anal plate brown, smooth, shiny. Length 1.8 mm.

Third instar. Head pale yellow-green, shiny. Body blue-green becoming yellow toward the yellow anal plate and bearing continuous white line above the prolegs, smooth, shiny. Head and body with blue conical tubercles. Length 10 mm.

Fifth instar (Fig. 1). Head pale yellow, shiny, rough. Body blue-green with mid-dorsal yellow line and white line above prolegs. Head and body with conical tubercles and bristles. Length 35 mm.

Pupa (Fig. 2). Yellow, smooth, shiny, with black dorsal and subdorsal spots, a thin anterior spine with tip black and curved upwards, a strong dorsal thoracic ridge, abdomen with segments 2 to 4 produced laterally into flat black spines, those on 3 and 4 with white centres, cremaster translucent white. Length 27 mm.

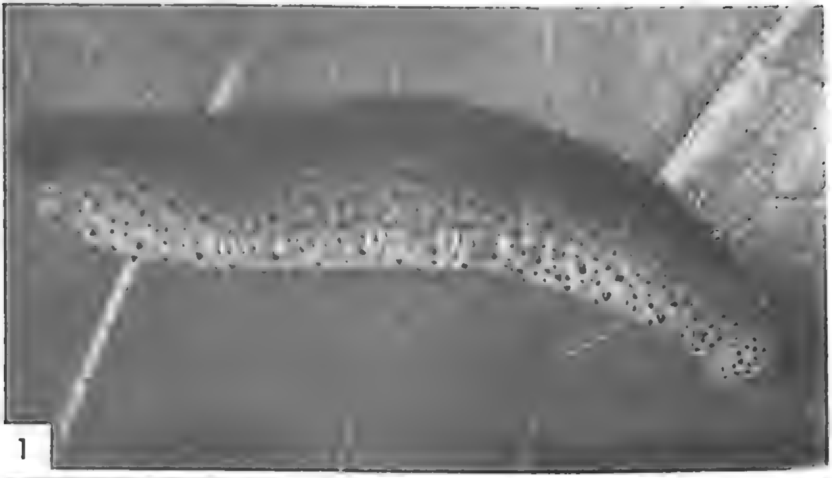
Foodplant. *Crateva religiosa* (Forst.) Capparidaceae.

Notes

Eggs are laid singly on the new growth of the foodplant. Larvae rest on silken pads constructed on the midrib of a leaf. Only new growth is consumed by the larvae, which perish if restricted to mature leaves. Pupae are suspended beneath the leaves and branches of the foodplant. Adults may be common after rain has produced a flush of new growth on the foodplants.

The life cycle takes approximately three weeks in the summer months; egg four days, larva ten days, pupa six days.

A. ada caria ranges from the Dulcie River to McIlwraith Range, and further south between Cape Tribulation and Daintree (Common and Water-



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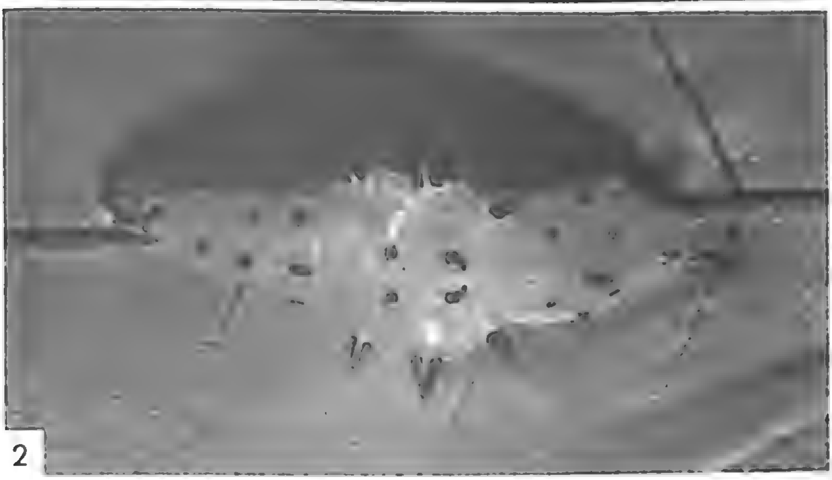

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Figs 1, 2. *Appias ada caria* Waterhouse and Lyell: (1) fifth instar larva; (2) pupa, dorsal view.

house 1981). It is interesting to note that the larval food plant has a similar distribution in Australia except that it is not recorded from the Cape Tribulation/Daintree area.

Acknowledgement

I wish to thank Mr A. K. Irvine, Division of Forest Research, C.S.I.R.O. Atherton, for identifying the food plant.

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THE OCCURRENCE IN AUSTRALIA OF *CHTHONIUS TETRACHELATUS* (PREYSSLER) (PSEUDOSCORPIONIDA: CHTHONIIDAE)

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Abstract

The introduced pseudoscorpion species *Chthonius (Ephippiochthonius) tetrachelatus* (Preyssler) is recorded from Australia for the first time based on specimens collected in a suburban garden in Melbourne, Victoria.

Six genera of Chthoniidae have been recorded from Australia (Harvey 1981) and all of the species so far described appear to be endemic. Thus, specimens of *Chthonius tetrachelatus* (Preyssler, 1790) recently collected under rocks in a suburban garden in Melbourne, Victoria are of interest because this cosmopolitan species has not previously been recorded from Australia. It is widely distributed in Europe, North Africa, North America (Vachon 1941a) and Argentina (Hoff 1950), and is often found in greenhouses and gardens (Jones 1980). *Chthonius tetrachelatus* has been described several times in the literature (Hadži 1933; Vachon 1941a, 1941b; Dumitresco and Orghidan 1964; Ćurčić 1972; Legg 1975), but an abbreviated description of the Australian material is provided to allow for comparison with specimens from other countries.

Terminology follows that of Chamberlin (1931).

Chthonius tetrachelatus (Preyssler)

Material examined: VICTORIA: Surrey Hills, 11 Sept. 1981, M. S. Harvey, under rock in garden, 2 ♂, 3 ♀, 1 tritonymph (MH347.01-06), deposited in Museum of Victoria, Abbotsford; same data except 9 Jan. 1982, 1 ♀ (MH356.01), deposited in Australian National Insect Collection, Canberra.

Description: Pedipalps: femur 6.26-6.32 (♂), 5.56-6.29 (♀), tibia 1.95-2.14 (♂), 1.96-2.00 (♀), chela 5.41 (♂), 4.92 (♀) times longer than broad. Fixed chelal finger with 21-22 (♂), 24-26 (♀) teeth, the first 14-15 of which are separated by two to three times the basal length of a tooth; moveable chelal finger with 17 (♂), 18 (♀) teeth, the first six to seven widely spaced and separated by approximately three times the basal length of a tooth; moveable chelal finger without proximal lamella but with a pronounced apodeme. Anterior eyes corneate, posterior eyes represented by a white spot; separated from each other by a little less than the diameter of one eye. Carapaceal chaetotaxy: mm4mm: 6: 4: 2:2, occasionally extra microsetae (m) are present on anterior and posterior rows (see below). Chaetotaxy of sternites II-IV: ♂, 10. (3)14-16/10(3): (2)7(2); ♀, 10: (3)9-10(3): (2)7-8(2). Genitalia as described by Legg (1975) except for the distal ends of the male dorsal apodeme which are blunt and irregularly serrate in the Australian specimens but acuminate in Legg's figures.

Dimensions (mm) ♂ (♀): Pedipalps: femur 0.595-0.60/0.095 (0.64-0.66/0.105-0.115), tibia 0.215-0.235/0.11 (0.25-0.26/0.125-0.13), chela 0.78-0.805/0.145 (0.865-0.89/0.18), hand length 0.315-0.325 (0.37-0.385), moveable finger length 0.435-0.465 (0.48-0.50).

Discussion

The Australian material runs to *C. tetrachelatus* in Beier's (1963) key to the European fauna (notwithstanding the uncertainty of couplet 65 where one must determine the condition of the posterior eyes), and in most regards the specimens fit the available descriptions. However, as currently defined this species is extremely variable in size (e.g. pedipalpal femur length 0.48-0.75 mm; see summary of published measurements in Ćurčić 1972) and the possibility exists that more than one species has been confused under this name.

The number of setae on the posterior carapaceal margin has been cited as a specific character in the genus but considerable variation exists and this character should be used with caution. The Australian material of *C. tetrachelatus* varies from two long setae (4 ♀), two long setae and one microseta (1 ♂) to two long setae and two microsetae (1 ♂). Similar observations have been made by Hadži (1933), Vachon (1941a), Hoff (1951), Helversen (1966), Nelson (1975) and Callaini (1979).

Chthonius tetrachelatus is currently the only species of the genus to be recorded from Australia and is distinguished from all other known Australian chthoniid species by the dorsal depression of the chelal hand slightly anterior to trichobothria *ib* and *isb* (Vachon 1941a, fig. 14; Hoff 1949, fig. 14b), the feature that is diagnostic of the subgenus *Ephippiochthonius.* The genus *Chthonius* is distinguished from the other genera known to occur in Australia by the presence of short, pennate coxal spines on both coxae II and III.

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CORRECTIONS TO A. F. ATKINS, 1984, 'A NEW GENUS *ANTIPODIA* (LEPIDOPTERA: HESPERIIDAE: TRAPEZITINAE) WITH COMMENTS ON ITS BIOLOGY AND RELATIONSHIPS'

By A. F. Atkins

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The following corrections are given for my paper (Atkins, 1984).

Page 49—reference given for Couchman and Couchman should be '1977' not '1978'.

Page 50, last paragraph—'Type. New South Wales:' should read 'Type. SOUTH AUSTRALIA: '.

On the same line 'Adrossan' should read 'Ardrossan'.

Page 52, 4th paragraph, 3rd line—'*Hesperilla atralba dactyliota* (Meyrick), Miskin 1891' should read '*Hesperilla dactyliota* (Meyrick), Miskin 1891'.

Page 56, 3rd paragraph, line 5—'. . . and the small, bright subspecies from . . .' should read'. . . and small, bright specimens recorded from . . .'.

4th paragraph—'The species assigned to *Antipodia* cannot be distinguished by the larval and pupal characters to trapezitine, . . .' should read 'Larval and pupal characters of the species assigned to *Antipodia* differ from those of the trapezitine, . . .'.

Page 58—references given for Couchman and Couchman should be '1977' and not '1978'.

I thank Mr L. E. Couchman for bringing to my notice some of these errors and to Mr E. D. Edwards for advice and information.

Reference

Atkins, A. F., 1984. A new genus *Antipodia* (Lepidoptera: Hesperiidae: Trapezitinae) with comments on its biology and relationships. *Aust. ent. Mag.* 11(3): 45-58.

NEW RECORDS OF SCARABAEIDAE (COLEOPTERA) FROM CENTRAL AUSTRALIA

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Abstract

New distribution records and collection notes are presented for 45 species of Scarabaeidae collected in central Australia. Subfamilies represented are: Melolonthinae, 18 species; Aclopinae, 1 species; Dynastinae, 6 species; Rutelinae, 1 species; Scarabaeinae, 5 species; Aphodiinae, 1 species; Geotrupinae, 13 species.

Introduction

Central Australia lies within the area delimited by the 380mm isohyet of median annual precipitation for the summer maximum rainfall areas and by the 255 mm isohyet for the winter maximum or seasonal uniform rainfall areas in the south (Taylor and Shurcliff 1983). The topography is typified by a number of distinct east-west ranges forming an archipelago of more mesic habitats within a xeric sea of dune fields, sand plains, gibber plains and salt flats. This suggests that the ranges may be important resevoirs of biological diversity and also that they may function as refugia during periods of increased aridity (Taylor and Shurcliff 1983).

In common with the range flora, the range fauna (and indeed the fauna of all central Australia) has been collected only sporadically, with most collecting being concentrated on the MacDonnell Ranges (Taylor and Shurcliff 1983). During the course of two visits to central Australia (by the senior author in April 1978 and by both authors in April-May 1982) scarabs were collected at a number of sites. The second visit we think very important as it occurred 4-5 weeks after very heavy and wide-spread rainfall—153 mm at Giles Weather Station for 26-28 March and 230 mm at Ayers Rock for 25-28 March.

Melolonthinae

Lepidiota squamulata Waterhouse
1, 20 km NW of Areyonga, N.T., 4.v.1982.

A very abraded and dark brown specimen found dead. This species is the most widely distributed species of the genus in Australia and has previously been recorded from three localities in central Australia (Britton 1978). The new record extends the known Northern Territory distribution towards that of Western Australia.

Liparetrus semiatriceps Lea
1, Giles Weather Stn, W.A., 30.iv.1982.

Known from four localities in central Australia (Britton 1980). The present record extends the distribution to the south and bridges the gap between the Coniston Station, N.T., and Cossack-Millstream, W.A., records. The specimen was dead when found.

Liparetrus sp.
1, Docker River, N.T., 28.iv.1982.

An apparently new species (Britton pers. comm.) belonging to the *rufipennis* species-group but it will not key out past couplet 195 (Britton 1980) as the antennae are missing. Three other species of the *rufipennis* species-group, *semiatriceps, distinctus* Lea and *politus* Britton, are known from the southern Northern Territory. The present specimen was dead when found in a spiders web and is in poor condition. Further specimens would be required before a new species could be described.

Colpochila rufocastanea (Lea)
12, Giles Weather Stn, W.A., 30.iv.1982; Wallara, N.T., 2.v.1982.

All specimens were dead when found. The type locality is the Peterman Ranges (Lea 1930).

Colpochila spadix (Blackburn)
1, Alice Springs, N.T., 20.iv.1978.
Collected at light. Blackburn (1906) gives the type locality as the Murchison district, N.W. Australia.

Colpochila sp. "g"
1, Marla Bore, S.A., 25.iv.1978; 3, Ayers Rock, N.T., 25-27.iv.1982.
All specimens were attracted to light. The species is described by E. B. Britton in his forthcoming revision of the genus.

Colpochila sp. "r"
1, Curtin Springs, N.T., 23.iv.1978.
Although dead when collected, the specimen was fresh and apparently had been attracted to light. It is to be described by E. B. Britton.

Gnaphalopoda simplex (Lea)
1, Giles Weather Stn, W.A., 30.iv.1982.
Dead when collected. The type locality is the junction of the Fitzroy and Margaret Rivers N.W. Australia (Lea 1917), about 800 km to the north-west.

Gnaphalopoda bidentata (Lea)
3, Ayers Rock, N.T., 25-27.iv.1982; 5, Giles Weather Stn, W.A., 30.iv.1982.
Specimens from Giles were dead when collected, those from Ayers Rock were attracted to light. The type locality is either Murat Bay or Ooldea, South Australia (Lea 1917), over 550 km to the south.

Sciton sp. "a"
4, Giles Weather Stn, W.A., 30.iv.1982.
A species to be described by E.B. Britton. The specimens were dead when collected.

Heteronyx sp. nr. *doddi* Blackburn
1, Ayers Rock, N.T., 25-27.iv.1982.
An apparently undescribed species (E. B. Britton, pers. comm.) taken at light. The type locality of *H. doddi* is Sth. Queensland but other closely-related species, e.g. *squalidus* Blackburn, *dispar* Blackburn and *litigosus* Blackburn, are known from inalnd arid Australia (Blackburn 1908).

Heteronyx sp. nr. *apterus* Blackburn
1, Reedy Rockhole, near Kings Canyon, N.T., 3.v.1982.
An apparently undescribed species (E. B. Britton pers. comm.) taken at light. The type locality of *H. apterus* is Perth (Blackburn 1910).

Heteronyx sp. 1
1, Marla Bore, S.A., 25.iv.1978.
Taken at light.

Heteronyx sp. 2
5, Giles Weather Stn, W.A., 30.iv.1982.
Dead when collected. Some specimens were very bleached.

Heteronyx sp. 3
1, Giles Weather Stn, W.A., 30.iv.1982.
Dead when collected.

Heteronyx sp. 4
1, Giles Weather Stn, W.A., 30.iv.1982.
Dead when collected.

Heteronyx sp. 5
1, Giles Weather Stn, W.A., 30.iv.1982.
Dead when collected.

Sphyrocallus sp.
3, 10 km W of Docker River Settlement, N.T., 30.iv.1982.

Flying about mid-day. One specimen landed on the edge of a camp fire and the others were found in a large shallow pan of water which had been exposed for only about 30 minutes. Other specimens were seen but they evaded capture. The genus belongs to the Systellopini of which there are 14 described species (Dalla Torre 1912). The majority occur in inland Australia and are poorly known. Sharp (1877) provided a key to eight species and the above specimens key to *S. brunneus* Sharp. They do not, however, agree with a specimen labelled as such in the South Australian Museum or with the description of *S. bicolor* Blackburn (1905) and probably represent a new species.

Aclopinae

Phaenognatha angusta Arrow
1, Tea Tree, N.T., 20.iv.1978.

The species occurs in the central and northern parts of the Northern Territory and the inland part of Queensland (Allsopp 1981). This specimen was collected outside the window of an isolated building indicating it had been attracted by light.

Dynastinae

Cryptoryctes wingarus Carne
1, Curtin Springs, N.T., 23.iv.1978.

This species was known only from the holotype male collected at an unknown location in Western Australia in November 1897 (Carne 1957a). The present specimen, a male, was found dead and had the middle and hind legs missing. The lateral points of the anterior horns are longer and more curved than those of the holotype (Carne 1957a, fig. 415).

Semanopterus rectangulus Blackburn
1, Ayers Rock, N.T., 25-27.iv.1982; 1, Glen Helen, N.T. 5.v.1982.

A species widely distributed throughout Australia. The above represents two new locality records and extends the collection dates to May.

Neodon bidens (Blackburn)
2, Ormiston Gorge, N.T., 6.v.1982; 3, Ellery Big Hole, N.T., 7.v.1982.

Carne (1957a) records this species from only Alice Springs and Tennant Creek during November. The Ormiston Gorge record extends the range more than 100 km to the west.

Neodon glauerti Carne
1, Ayers Rock, N.T., 25-27.iv.1982; 8, Giles Weather Stn, W.A., 30.iv.1982.

All specimens were dead when collected. Collected previously at Onslow and Roebourne, W.A. and Alice Springs (Carne 1957a), the new specimens help close the gap in the distribution. The only previous date of collection was in November.

Neodon pecuarius Reiche
3, Ayers Rock, N.T., 25-27.iv.1982.

A species widely distributed throughout Australia and previously collected in all months except July (Carne 1957a).

Cryptodus caviceps Westwood
3, Ayers Rock, N.T., 25-27.iv.1982; 3, Giles Weather Stn, W.A., 30.iv.1982.

Widely distributed throughout Australia but previously only recorded in central Australia from the Musgrave Ranges (Carne 1957a). The specimens from Giles were dead when collected but those from Ayers Rock were attracted to lights. The collection period is extended to April.

Rutelinae

Anoplognathus macleayi macleayi Blackburn
1, Giles Weather Stn, W.A., 30.iv.1982; 2, Palm Valley, N.T., 4.v.1982; 1, Glen Helen, N.T., 5.v.1982.

Specimens were dead when collected and severely weathered. Known only from central Australia (Carne 1957b, 1958, 1981). The Giles record is much further west than the distribution boundary for *Anoplognathus* shown by Carne (1958, map 1).

Scarabaeinae

Euoniticellus intermedius Reiche
1, Marla Bore, S.A., 25.iv.1978

A species introduced from Africa (Bornemissza 1976) and now widely distributed in inland Australia. The specimen was taken from under cow dung.

Onitis alexis Klug
1, Alice Springs, N.T., 24.iv.1982.

Collected at light. An introduced species from Africa (Bornemissza 1976) and now widely distributed in inland Australia.

Onthophagus consentaneus Harold
1, Wallara, N.T., 2.v.1982.

This species has the most extensive distribution of any Australian *Onthophagus* sp. (Matthews 1972). In central Australia Matthews records it from around Alice Springs and Hermannsburg. The specimen was taken in cow dung.

Onthophagus sloanei Blackburn
2, Alice Springs, N.T., 24.iv.1982; 1, Ayers Rock, N.T., 25-27.iv.1982; 3, Wallara, N.T., 2.v.1982; 1, Palm Valley, N.T., 4.v.1982; 1, Glen Helen, N.T., 5.v.1982; 1, Ellery Big Hole, N.T., 7.v.1982.

Specimens were taken at light and in cow dung. Matthews (1972) records it from numerous localities in central Australia. It is the most xerophilic of Australian *Onthophagus* spp. and is evidently adapted to live primarily in areas of about 200-250 mm of annual rainfall.

Onthophagus sp. nr. *clypealis* Lea
1, Ayers Rock, N.T., 25-27.iv.1982.

Undoubtably a new species (R. I. Storey pers. comm.). Other species of the *planicollis* group are found on the east coast and around the Gulf of Carpentaria but all are rare and nothing is known of their ecology (Matthews 1972).

Aphodiinae

Aphodius lividus Olivier
1, Alice Springs, N.T., 24.iv.1982; 1, Wallara, N.T., 2.v.1982.

A species accidently introduced from Europe and now widely distributed. The first specimen was taken at light, the second in cow dung.

Geotrupinae

Blackburnium macleayi (Blackburn)
1, Tea Tree, N.T., 20.iv.1978.

Howden (1979) remarked on the apparent disjunct distribution of this species in eastern Queensland and coastal central Western Australia. This record bridges the gap between these records. It was found dead outside a window and had presumably been attracted to light.

Blackburnium sloanei (Blackburn)
2, Ayers Rock, N.T., 25-27.iv.1982; 4, Wallara, N.T., 2.v.1982.

Taken in burrows at Wallara and at light at Ayers Rock. The Wallara burrows were in a well-watered lawn surrounding the homestead and the beetles were only about 10 cm below the surface. The species is widely distributed across Australia, the present records are to the south-west of the previous central Australian collections (Howden 1979).

Blackburnium cooperi Howden
1, Wallara, N.T., 2.v.1982.

Taken in burrows in the same area as *B. sloanei*. The only previous record from the Northern Territory was Ayers Rock (Howden 1979), 170 km to the south-west.

Blackburnium harslettae Howden

1, Ayers Rock, N.T., 25-27.iv.1982; 1, Wallara, N.T., 2.v.1982.

Known previously from the Northern Territory only from Ayers Rock (Howden 1979). The Wallara specimen is a male major and is the first of that development to be collected; the type series was three minor males, one female and one whose sex was not stated. Howden (1984) contends that this major male demonstrates that *B. harslettae* and *B. triceratops* Howden are distinct species despite the reservations expressed by Howden (1979: 61). The Wallara specimen was dug from a burrow and the other collected at light.

Blackburnium centrale Howden

2, Ayers Rock, N.T., 25-27.iv.1982; 1, Ayers Rock, N.T., 1.v.1982.

All specimens were collected at light. These records extend the known distribution *ca* 100 km to the east from the record of the paratype at Armstrong Creek, N.T. (Howden 1979).

Blackburnium sp.

1, Ayers Rock, N.T., 25-27.iv.1982.

A female taken at light which could not be assigned to any species.

Bolborachium sp. nr. *fissicorne* (Bainbridge)

1, Alice Springs, N.T., 24.iv.1982.

Collected from a burrow 15 cm deep in a well-watered lawn.

Bolborhachium sp. "k"

2, Ayers Rock, N.T., 25-27.iv.1982.

A new species to be described by H. F. Howden. Howden and Cooper (1977, fig. 76) do not show any *Bolborhachium* spp. occurring in central Australia, although one species has an apparent disjunct distribution in south-western Western Australia and south-central Queensland that might be a reflection of inadequate collecting. The specimens were attracted to light.

Bolboaeinus planiceps (Macleay)

2, Ayers Rock, N.T., 25-27.iv.1982.

Collected at light. *Bolbobaeinus* spp. are known from northern Australia and some dry inland localities south to South Australia (Howden and Cooper 1977).

Bolboleaus truncatus (Blackburn)

1, Alice Springs, N.T., 24.iv.1982; 1, Ayers Rock, N.T., 25-27.iv.1982; 9, Giles Weather Stn, W.A., 30.iv.1982; 2, Wallara, N.T., 2.v.1982; 1, Tea Tree, N.T., 20.iv.1978.

The first two specimens were collected at light, those from Giles and Tea Tree were dead when collected and those from Wallara were dug from burrows 10-15 cm deep. Howden and Cooper (1977, fig. 75) do not record any *Bolboleaus* spp. from south-western Northern Territory or adjacent areas of Western and South Australia. The type locality is 'N. Queensland' (Blackburn 1904).

Australobolbus basedowi (Blackburn)

1, Giles Weather Stn, W.A., 30.iv.1982.

Dead when collected. The type locality is Central Australia', the specimens probably coming from the Musgrave Ranges (Blackburn 1904).

Australobolbus laevipes (Blackburn)

5, Ayers Rock, N.T., 25-27.iv.1982; 1, Giles Weather Stn, W.A., 30.iv.1982.

The Ayers Rock specimens were collected at lights, that from Giles was dead when collected. The type locality is 'N.W. Australia' (Blackburn 1904).

Australobolbus sp. nr. *carinatus* (Blackburn)

2, Ayers Rock, N.T., 25-27.iv.1982; 3, Giles Weather Stn, W.A., 30.iv.1982; 1, Tea Tree, N.T., 20.iv.1978.

Those from Ayers Rock were collected at lights while all specimens from Giles and Tea Tree were dead when collected.

Acknowledgements

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A NEW GENUS OF CLUBIONOID SPIDER FROM WESTERN AUSTRALIA (ARACHNIDA: ARANEOMORPHAE)

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Abstract

A new, clubionoid, monotypic genus is described from midwestern Western Australia. It is arid-adapted, lives in sandy habitats and is conjectured to feed on ants.

Introduction

The spider fauna of the northern two thirds of Western Australia is poorly known compared to that of other regions of Australia. Few species from the area have been mentioned in the taxonomic literature apart from several species named from near Shark Bay (Simon, 1908, 1909), one species from Roebourne (Hogg, 1903), 20 species listed from the Montebello Islands (Hogg, 1914), 10 species from the north-west of Western Australia (Rainbow and Musgrave, 1918) and the occurrence of *Conothele* in the Kimberleys (Main, 1957). Nevertheless it is known from various collections, particularly those in the Western Australian Museum, and naturalists' observations that a diverse and largely undescribed spider fauna exists north of the Murchison region.

Thus it is not surprising that a specimen of a new genus which cannot unequivocally be attributed to a family has been found amongst recently sorted material in the Western Australian Museum. The spider clearly fits in the Clubionoidea (Levi, 1982). Although it shares individual salient characters with one or more of the cluboinoid families it possesses a distinctive combination of characters. In addition it possesses a unique character–tubular spiracular openings in the epigastric groove.

On the slender evidence of a single specimen, I am reluctant to add yet another spider family to the already long list of taxa. One alternative would be to lump all the clubionoid families except the Gnaphosidae and Platoridae and include them in the Clubionidae. The latter families are alternatively placed in a separate superfamily, the Gnaphosoidea (Platnick, 1984). The retention of the families in question, e.g. Ammoxenidae, Homalonychidae, Cithaeronidae, Gallieniellidae (the latter two also placed in the Gnaphosoidea by Platnick (1984)) appears justified on biogeographic and biological criteria. Each family is representative of a desert or dry region on a separate continent, island or connected region–the Homalonychidae in Mexico and south-western U.S.A., the Ammoxenidae in Africa, the Cithaeronidae in Africa through to India (see Levi 1982), the Gallieniellidae in Madagascar and the Comoro Islands (Platnick, 1984)–as is also the new genus *Meedo* from mid-western Western Australia. The Ammoxenidae, Homalonychidae, and probably the Cithaeronidae, (all monogeneric families) and *Meedo* are all characteristic of sandy desert habitats, the Gallieniellidae of forest litter [generally the dry sclerophyll forest of Madagascar but also including montane humid habitats

(Platnick, 1984)]. It is possible that each family and *Meedo* represents a separate, analogous derivation from a clubionoid or gnaphosoid stock in response to an arid habitat. Certainly the tubular spiracular openings of *Meedo* appear to be an adaptation to reduce dessication and infiltration of the respiratory organs by sand. It is even possible that the lung books may have been replaced by tracheae. It is noteworthy that certain peculiarities of some of the above taxa, for example the paraxial chelicerae of the Gallieniellidae and *Meedo*, occur also in males of some clubionid genera such as *Clubiona* and *Chiracanthium.*

Because of the uncertain family status of the new genus it is placed tentatively in the Clubionidae–the traditional "dumping ground" for many doubtful genera, and with which it shares some features. If retained in the Clubionidae, a new subfamily may be designated later. However additional specimens including a male, are required before the spider's affinity is resolved.

The following description of the new taxon is necessarily brief because it is undesirable to dissect the single specimen for examination by a scanning electron microscope. Closer examination of the cuticular structures and clearing of the respiratory system would be particularly enlightening.

Meedo n. gen.

Type species: Meedo houstoni n. sp.

Etymology: The name is taken from the station on which the spider was found.

Diagnosis (based on female only)

Body elongate with cylindrical abdomen; superficial gnaphosid appearance. Eye group slightly less than half the width of the caput. Fovea a narrow, triangular cleft, apex directed posteriorly. Paraxial, porrect chelicerae with basal hump or boss, teeth absent, very long fang. Labium broad, short, anterior part lobate; sclerotised, stem-like base, distinct from sternum. Endites (maxillae) with median depression. Sternum heart-shaped, flat, very broad anteriorly. Two tarsal claws, with several teeth. Claw tufts, spines and trichobothria absent from legs. Fourth legs extraordinarily long. Six spinnerets, terminal segments broadly conical; anterior pair not contiguous. A pair of tube-like spiracles in epigastric furrow.

Comments

The genus shares some distinctive characters with the Gallieniellidae, namely the porrect, paraxial chelicerae with very long fang, the medially depressed endites (maxillae), the fourth legs longer than the first and the toothed tarsal claws. It differs by the absence of cheliceral teeth, the typical clubionid-like spinnerets and the very broad, short, lobate labium, round eyes and the tube-like spiracles. There is some similarity with other monogeneric clubionoid families (see Levi, 1982) e.g. the Ammoxenidae, Homalonychidae and Cithaeronidae all of which lack cheliceral teeth. *Meedo* is excluded from these families primarily by the paraxial chelicerae. The Ammoxenidae are

further distinguished by the labium which is fused to the sternum, long posterior spinnerets and long, articulated tarsi. Both the Homalonychidae and the Cithaeronidae differ by having contigous anterior spinnerets on a common base and by having either claw tufts or spathulate setae. In addition the Homalonychidae have trichobothria and lack teeth on the tarsal claws.

Meedo houstoni n. sp.

(Figs 1-8)

Type: *Holotype* ♀, 10 km ESE of Meedo station homestead, Western Australia (25° 40′S 114° 37′E), 3-26 August, 1980, pitfall trap on red sand dune, C. A. Howard and T. F. Houston (336-23). Western Australian Museum, 1984/654.

Description

With the characters of the genus. Carapace (Fig. 5) length 2.6 mm, width 2.3, caput width approximately 1.2. Abdomen (Figs 2, 3) length 5.5, width 2.5, height 2.4. Colour yellowish to tan with dark greyish smudges along sides of legs, between and posterior to eyes; articulations of appendages darker brown; abdomen ventrally uniformly pale yellowish grey, dorsally with a dark grey marbled pattern with pale patches. Under low power stereo microscope, carapace and abdomen are glabrous and appear devoid of hairs and bristles except for a group of short bristles in front of eyes. Legs (Figs 1, 4) glabrous, with fine hairs and a ventral, brush-like arrangement of short bristles (pseudoscopula?) on tarsi. Chelicerae clothed with short bristles.

Eye group 0.7 wide. Posterior row of eyes strongly procurved. Integument has lifted which gives the eyes a double-lensed appearance (Fig. 5). Chelicerae project 0.8 in front of caput, length in profile 1.4; strongly porrect with a median dorsal prominence and large, bulbous pale boss; fine bristles along inner (pro) margin of groove but without teeth. Labium twice as wide as long–0.2 long, 0.4 wide. Maxillae with broad base and long endite lobes. Sternum (Fig. 6) approximately 1.6 long, 1.3 wide. Very broad in

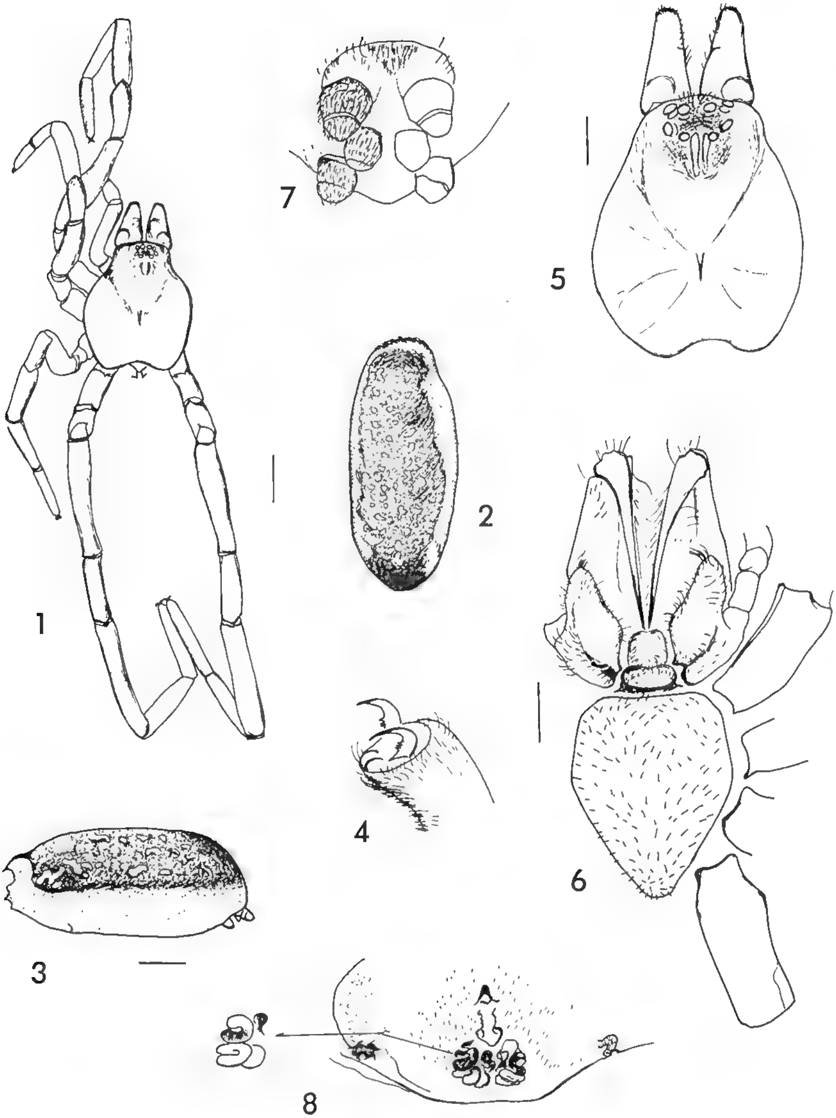
TABLE 1

Leg formula and measurements of *Meedo houstoni* sp. nov. The leg formula is length of leg/length of carapace. The tibial index is 100 x width of patella/(length of patella + length of tibia) (Petrunkevitch, 1942).

Leg formula:	4	1	2	3
	4.26	3.46	2.46	2.07

Leg	F	P	T	MT	T	Total
I	2.3	1.4	2.1	1.8	1.4	9.0
II	1.7	1.1	1.3	1.4	0.9	6.4
III	1.2	0.8	1.1	1.4	0.9	5.4
IV	2.6	1.4	2.5	2.9	1.7	11.1
PALP	1.0	0.5	0.5	–	0.7	2.7

Width of patella I at "knee", 0.3. Tibial index, 8.57
Width of patella IV at "knee", 0.35. Tibial index, 8.97



Figs 1-8. *Meedo houstoni* n. sp., ♀ holotype. (1) carapace and appendages; (2) abdomen, dorsal view; (3) abdomen, profile; (4) tarsal claws of right leg II (note ventral sclerotised groove); (5) carapace and abdomen; (6) sternum and coxae, labium, maxillae (endites) and chelicerae; (7) spinnerets; (8) spiracles and epigynum (uncleared) with spermathecae visible through integument.
Scale bars, (1)-(3) = 1.0 mm; (5), (6) = 0.5 mm; others not to scale.

anterior and mid-region, anterior margin straight; clothed with short, rod-like hairs. Fourth pair of legs very long (Table 1) with tarsi and metatarsi bent forwards underneath. Six spinnerets (Fig. 7) about equal length. Epigynum inconspicuous, with weakly sclerotised longituninal, trough-like piece anterior to convoluted spermathecal tubes which are clearly visible through integument (Fig. 8).

Discussion

The glabrous, sparsely clothed integument and constricted spiracular openings and the occurrence in a red sand dune habitat suggest that the spider is arid-adapted. As noted earlier the tube-like spiracles would reduce dessication and prevent sand infiltration of the respiratory organs. The very long posterior legs which appear to be naturally bent suggest a spring-like action which may be associated with catching ants by rapid forward lunges when the legs are straightened. Significantly the Gallieniellidae which similarly have paraxial chelicerae with a long fang, and long posterior legs, are ant feeders (Legendre, 1967).

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CORRECTION TO MOULDS, M. S., 1986, 'THE HAWK MOTHS (LEPIDOPTERA: SPHINGIDAE) OF CHRISTMAS ISLAND, INDIAN OCEAN'

By M. S. Moulds
c/- Dept. of Entomology, Australian Museum, 6-8 College St, Sydney, N.S.W. 2000

In my paper on the hawk moths of Christmas Island (Moulds, 1986) the specimens identified as *Hippotion velox* (F.) do, in fact, belong to *Hippotion swinhoei* (Moore) and should go under that name.

Dr J. C. E. Riotte has kindly brought to my attention two papers concerning *H. swinhoei* from Christmas Island that I had overlooked. Clark (1923) named *H. noel* from two specimens taken on Christmas Island. Riotte (1977) showed that *H. noel* Clark is a junior synonym of *H. swinhoei*. Only *H. swinhoei* is known from Christmas Island and all Christmas Island specimens previously assigned to *H. velox* should be called *H. swinhoei*. My key to last instar larvae will almost certainly continue to function as a means of identifying *H. swinhoei* larvae by substituting this name for *H. velox*.

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BOOK ANNOUNCEMENT

Venoms of the Hymenoptera: biochemical, pharmacological and behavioural aspects edited by Tom Pick. 1986. Academic Press, London. (Academic Press Australia, 30-32 Sidmore St, Marrickville, N.S.W. 2204). xi, 570 pages, illust. Price US$92 (cloth), US$49.95 (paperback).

Since the mid-1960s knowledge concerning Hymenoptera venoms has far exceeded that of the preceding period in history. This book summarises and updates our research in this field.

The book is divided into 10 chapters written by 8 authors recognised worldwide as authorities in this field. Subjects covered include morphology of the venom apparatus, methods of venom collection, stinging behaviour, chemistry and pharmacology of wasp, bee and ant venoms, and allergy to Hymenoptera venoms. Each chapter not only provides extensive documentation of current knowledge but includes a comprehensive list of primary literature. The index to the book covers 24 pages.

For the Hymenopterist the book is an essential reference. As the Preface states the information contained in it "will be important not only to experimental entomologists and behaviourists . . . but also to physiologists and pharmacologists interested in allergy and neurotoxicology, to biochemists interested in natural products, and to researchers involved in the development of neuropharmacological drugs and new classes of pesticides."

BOOK ANNOUNCEMENT

Advances in insect physiology, Volume 18. December, 1985. Academic Press, Orlando (Academic Press Australia, 30-32 Sidmore St, Marrickville, N.S.W. 2204). vii, 445 pages, illustr. Price US$79.50/£65.00.

Six important papers are included in this latest volume. They cover a wide spectrum of insect physiology, i.e. ant pheromones, insect walking, cyclic nucleotide metabolism and physiology of *Drosophila*, Lepidoptera colour patterns, nonspiking interneurons and motor control in insects, and structure and regulation of the corpus allatum. The nine authors are all prominent in their fields.

These review papers are essential reading for anyone seriously interested in these fields. The importance of this Series as a whole is revealed by the subject titles included in the "Cummulative List of Chapter Titles" given at the back of each volume. If you have not examined a recent volume you should do so.

BOOK REVIEW

A colour atlas of insect tissues via the flea by Miriam Rothschild, Yosef Schlein and Susumo Ito. 1986. Wolfe Scientific Ltd, 3 Conway St, London W1P 6HE. 179 pages containing 281 colour and b. & w. photographs. ISBN 0 7234 0891 2. Rec. Australian price $112.00.

This remarkable book is one that I believe deserves wide publicity amongst entomologists and entomological students. It is basically a collection of colour light microscope photographs which illustrate the principal internal organs of an insect. Some line drawings and electron micrographs are also included.

The flea has been selected to illustrate insect structure because the internal anatomy is simple and generalised, and provides an excellent vehicle for the study of many other insects. Structures not found in the flea, or which may be difficult to visualise, are discussed and illustrated in an appendix. There is also a comprehensive index.

In the Preface the authors write that the book is, amongst other things, '. . . aimed at avoiding the confusion we ourselves experienced when first examining the internal organs of insects and were faced with interpreting sections of their tissues.' Although the book is designed primarily for students and workers who are dealing for the first time with the internal organs of an insect, this outstanding atlas will also provide practical reference for entomologists, zoologists and researchers in any field concerned with insect vectors.

The photographs included provide a comprehensive coverage and obviously have been carefully chosen. It is well bound and well printed. A copy should at least be in the library of every university and research institute concerned with insects. I have no idea how long stocks will last but I would order now–there is no substitute!

C. HOLMES

AN ACCUMULATIVE BIBLIOGRAPHY OF AUSTRALIAN ENTOMOLOGY

Compiled by M. S. and B. J. Moulds

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CONTENTS

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A guide to the

BEETLES OF SOUTH-EASTERN AUSTRALIA

by

BARRY P. MOORE
B.Sc., Ph.D., D.Phil.

Fascicle No. 7

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137 138

Figs 137-138. *Lamprima aurata* Lat. (Lucanidae). (137) ♂; (138) ♀.

Eucalyptus, Casuarina, and sometimes exotic garden trees. The two forms are very closely related and probably deserve no more than subspecific rank. *L. aurata* is the southern form, common in Tasmania, Victoria and the tablelands of New South Wales and may be distinguished by its less pronounced mesosternal process (the forward projection between the middle coxae). *L. latreillei* ranges southwards from the tropics to southern New South Wales (where it is largely coastal in distribution) and is generally of a more brilliant sheen in both sexes; the mesosternal process projects forward more than in *L. aurata.*

Ceratognathus species are small, coal-black beetles, irregularly marbled with greyish-white scales, *C. niger* Westw. (9-12 mm) (Fig. 126) being the best known of about six that occur in our area. Males of the species may be distinguished from their mates by their rather longer mandibles and antennal lamellae. These small Stag beetles fly by day and by night.

Among the night-flying forms, we have the small brown and common *Syndesus cornutus* Macl. (9-12 mm), with the mandibles markedly bifurcate in the male (Fig. 141), and the well named *Figulus lilliputanus* Westw. (6-7.5 mm), which is one of the smallest Stag beetles in the fauna. Both of these species come frequently to light. *Figulus regularis* Westw. (15-17 mm) (Fig. 127) is most often found in rotten logs, from southern N.S.W. to the tropics, and is by far the commonest species of the genus. All *Figulus* are black, heavily armoured and parallel-sided beetles, with the terminal segments of the antennae flattened, shiny and only weakly serrate; unlike most Stag beetles, they show no obvious sexual dimorphism.

Figs 127-135. Lucanidae. (127) *Figulus regularis* Westw.; (128) *Lissotes darlingtoni* Benesh, ♂; (129) *L. darlingtoni,* ♀; (130) *L. furcicornis* Westw., ♂; (131) *L. kershawi* Lea ♂; (132) *Lissapterus grammicus* Lea, major ♂; (133) *L. grammicus,* minor ♂; (134) *L. howittanus* Westw., major ♂; (135) *L. howittanus,* ♀; (136) *L. pelorides* Westw., major ♂. All approximately twice natural size.

Beetles of South-eastern Australia – B. P. Moore
Fascicle 7, pp. 101-116, July, 1986. ISBN 0 909451 16 8

Some species of *Rhyssonotus* (e.g., *nebulosus* Kirby) are fully winged and capable of flight but in others the elytra are cemented together and the underwings are greatly reduced. However, all members of this genus show a highly characteristic build, with rather short mandibles (especially in females) and a massive thorax. *R. nebulosus* (22-25 mm) (Figs 117-118) is dull black, its upper surface with attractive marblings of greyish-brown, particularly when freshly emerged; it ranges from southern New South Wales to far northern Queensland. *R. jugularis* Westw. (22-27 mm) (Figs 119, 120), dull reddish-bronze, occurs in the south-eastern wet forests, where it may be taken in late summer, from within or beneath very old rotten logs. *R. parallelus* Deyr. (19-20 mm) (Fig. 121) is much like a small *jugularis* but the sides of the elytra are less rounded and there is much less of the metallic lustre. This species has much the same range as its larger congener. *R. politus* Cart. (16-23 mm) (Fig. 122) occurs from Barrington Tops to Point Lookout in New England and is of a rather shining metallic bronze; it is confined to the wettest forests, whereas *R. costatus* Cart. (19-21 mm) (Fig. 124), dull coppery with strongly rugose and ribbed elytra, prefers the drier western slopes of the same ranges. *R. laticeps* Macl. (14-21 mm) (Fig. 123), bronze-black, and with a very broad head in the male, occurs in the mountains of southern Queensland. *R. grandis* Lea (25 mm), similar to *costatus* but much larger, is known only from the type specimen (a male) from Comboyne (N.S.W.), an area that is now largely cleared of tall forest.

The related genera *Cacostomus* and *Eucarteria* each contain a single winged species, *C. squamosus* Newm. (12-24 mm) (Fig. 125), black but largely covered with ashen-grey scales, is mainly nocturnal, whereas *E. floralis* Lea (7.5-11 mm) (Fig. 142), black, with a yellowish-brown streak on each elytron, is found in the daytime on flowers. Both species may be taken in northern New South Wales and Queensland.

Hoplogonus simsoni Parry (16-30 mm) (Fig. 143), dull black, is a flightless species known only from Tasmania, where it appears to be confined to the north-eastern region. Males are very variable in size and development but both sexes possess sharp spines at the hind angles of the pronotum and on the elytral shoulders.

The chief genera of purely flightless species are *Lissotes* and *Lissapterus*. In the former the antennae are lamellate apically, as is usual in the family, but in the latter the terminal segments are merely weakly serrate, much as in *Figulus*. Most *Lissotes* are restricted to Tasmania, where the rather numerous species, with their intricately overlapping ranges, are in urgent need of revision. However, four others are known from Victoria: *L. darlingtoni* Benesh (13-22 mm) (Figs 128, 129), common in the mountain forests eastward from Melbourne; *L. furcicornis* Westw. (13-19 mm) (Fig. 130), from the Otway Range and from S. Gippsland; *L. kershawi* Lea (13-17 mm) (Fig. 131) from Wilson's Promontory. The fourth is an undescribed species from the high alps. These small black Stag beetles and their larvae are mostly found beneath,

rather than within, old fallen timber; the males may usually be reliably identified on the form of the mandibles but all females are very similar and are difficult to determine, except by association with their mates.

Species of *Lissapterus* are more heavily built and are confined to the mainland wet forests of the Great Dividing Range. *L. howittanus* Westw. (24-34 mm) (Figs 134, 135) is quite common under fallen timber, in the mountains east of Melbourne; the male (Fig. 134) has a massive head which, in large specimens, is curiously excavated in front. *L. grammicus* Lea (14-27 mm) (Figs 132, 133) is much smaller overall and is very variable in the male; it ranges from Bodalla, northwards to Mt Cambewarra, in New South Wales. *L. hopsoni* Cart., from the lower slopes of the Mt Royal Range, NW of Newcastle, has the canthi more prominently projecting behind the eyes but otherwise, differs little from *grammicus* and is probably not a distinct species. At the highest levels of the same Range, at Barrington Tops, *L. tetrops* Lea (22-30 mm) occurs in the beech forests; it is an altogether flatter insect and the male anterior femora are bluntly dentate. A somewhat similar species (but with simple male anterior femora) occurs in the New England National Park, but has not yet received a name. *L. pelorides* Westw. (*montivagus* Benesh) (22-32 mm) (Fig. 136) is widespread in the New South Wales-Queensland border area and other species, as yet undescribed, are known from further north.

The higher classification of the Lucanidae and the number of subfamilies that should be recognised are still matters for discussion and research.

Family TROGIDAE

Tarsal formula: 5-5-5

Antennae: short, 10-segmented, lamellate

Medium-sized to rather large, stout heavily armoured beetles, with embossed or tuberculate sculpture; head deflexed, largely concealed from above by the prothorax; apex of abdomen entirely covered by the elytra; front tibiae weakly dentate; front tarsi very short; habits sluggish; larvae scarabaeiform, with three well developed pairs of legs.

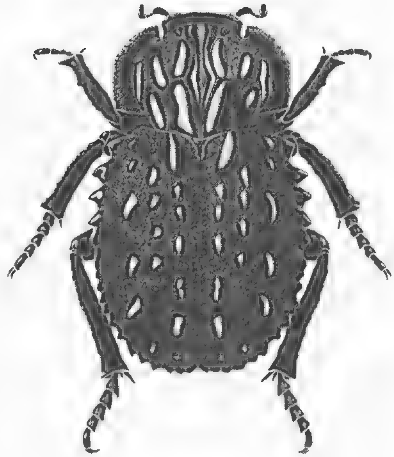


Fig. 139
Trox gigas Har.

Another uniform and easily recognised family, the Trogidae are mostly to be found under dried animal remains, where they represent the final stage in disintegration of the carcass. The winged species are also often attracted to lights at night. These beetles seem to have been very successful in adapting to the harsh conditions of the outback, where some of the most spectacular species occur. They are evidently able to eke a living from the desiccated remains of both native and domestic animals, which the dry climate soon renders quite unsuitable for most carrion-feeding insects, and they can also subsist on the dried droppings of dingoes and other carnivores, when carrion is scarce.

Trox F. is the dominant genus of the family and is the only one recognised in the local fauna. *T. gigas* Har. (23-28 mm) (Fig. 139), our finest species, is a dull black beetle, often encrusted with adherent dirt, and is flightless. The elytra are cemented together and are strongly and regularly tuberculate, with serrate margins. *T. dohrni* Har. is similar but smaller (15-22 mm), with the elytral tubercles less regularly aligned and the margins bluntly toothed. Both species just attain the western limits of the area covered by this work.

Trox tasmanicus Blbn (13-17 mm) is another flightless species, confined to Tasmania and Flinders Island, but here the elytra are separate and are irregularly rugose. By contrast, the fully winged species are less strongly but more regularly sculptured and their identification is often difficult. *T. australasiae* Er. (14-17 mm), *T. candidus* Har. (11-12 mm) and *T. crotchi* Har. (14-16 mm) are among those recorded from the south-eastern States. To these

must be added the European *T. scaber* L. (5-7 mm), which is now widespread in the region, and which is readily recognised by its small size. In its native haunts, this species is often found in owls' nests, where it subsists on regurgitated pellets and other discarded prey remains; quite possibly it will be found to have similar habits here.

The Australian Trogidae have been revised by Haaf (1954) and again, more recently, by Scholtz (1986).

Family SCARABAEIDAE
(Dung Beetles and Chafers)

Tarsal formula: 5-5-5 (rarely 0-5-5)

Antennae: 9- to 11-segmented, lamellate-clavate

Small to large, mostly heavily armoured species of varying form and habits, but build robust and front tibiae more or less dentate.

From the beginner's point of view at least, this large family presents a bewildering array but the subfamilies, of which there are eleven in this country, are fortunately more readily recognisable as discrete groups—and several of the important ones are currently under revision.

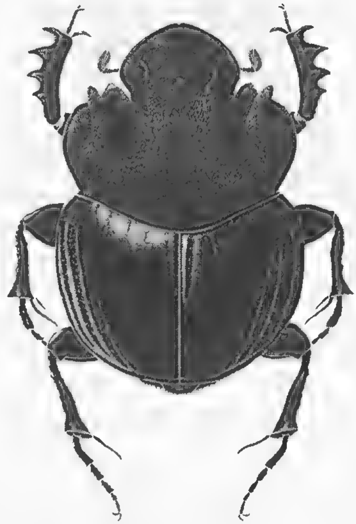


Fig. 140
Onthophagus pentacanthus Har.

Subfamily GEOTRUPINAE: medium-sized to rather large, stout and very convex, reddish-brown species; scutellum large; elytra completely covering abdomen; front tibiae with strong teeth for digging; antennae 11-segmented, with a lamellate and almost spherical club; head and prothorax often adorned with horns, prongs or tubercles and complex excavations, especially in males; larvae scarabaeiform, with peculiar cruciform anal lobes.

This subfamily, which is accorded family status by some authors, includes the European Dor beetles (*Geotrupes* spp.), one of which* has recently been introduced here under C.S.I.R.O.'s dung control program. Geotrupines could be confused only with the predominantly dung-feeding Scarabaeinae, but the latter have the tip (pygidium) of the abdomen exposed, lack a visible scutellum and show fewer than 11 antennal segments; scarabaeines are also generally much darker in colour. Although some exotic geotrupines feed on dung, many develop exclusively in subterranean fungi, which they detect by means of an acute sense of smell, located in the antennae. However the Australian species, as far as it known, are general detritus feeders. Most of our species are nocturnal and they frequently fly to light; when captured they stridulate loudly by rubbing the abdomen with a file on the hind coxae. The larvae live in underground caches of marsupial droppings, etc., provided by the adults.

* *G. spiniger* Marsham

Males of *Elephastomus* species have a long, forward-projecting horn on the front of the head that gives them a rather ridiculous appearance. In *E. proboscideus* Schreibers (15-21 mm) (Fig. 150), this horn is downturned and forked at the apex, whereas in *gellarus* Carne and *meraldus* Carne it is simple. The females are less readily identified and readers wishing to determine their captures should consult Carne's (1965) paper. This genus is confined to the well watered coastal fringe and adjacent tablelands of the east, from Queensland to Tasmania.

The other Australian geotrupines have recently been distributed (Howden and Cooper, 1977) between nine genera. Most of the finer species frequent the dry, sandy country of the outback and the west but a few extend to the western fringes of our region. *Bolboleaus quadriarmigerus* Howden (*armigerus* Macl.) (17-20 mm), pronotum with four divergent teeth, occurs in the Bogan River district of western New South Wales and *Blackburnium sloanei* Blbn (19-25 mm) (Fig. 151) is found in the Riverina and adjacent mallee areas. The males of these species are characteristically adorned with horns and excavations but all females are rather similar and are difficult to identify in the absence of their partners.

In eastern coastal districts several smaller species (5-15 mm), now placed in the genus *Australobulbus* Howden & Cooper, may be taken at light. Sexual dimorphism is at a minimum in this genus.

Subfamily HYBOSORINAE: small to medium-sized, globular species; antennae very short, 10-segmented, with a compact club; front tibiae with 2 or 3 sharp apical teeth; elytra entirely covering abdomen. When disturbed these beetles deflex the foreparts and roll into a ball.

A primitive subfamily of scavengers and largely confined to wet tropical forests, this group also has a few representatives in the well watered and well timbered regions of eastern New South Wales. The chief genus is *Liparochrus*: *L. silphoides* Har. (7-9 mm), (Fig. 144) dull black, the eytral striae very fine, shiny, rugose; *L. fossulatus* Westw. (5-7 mm), brilliant black, with strongly punctured striae. The species are more numerous in northern Queensland.

Subfamily APHODIINAE: small, parallel-sided, lightly built species; antennae 9-segmented; elytra completely covering abdomen; head and thorax unarmed; front tibiae dentate; larvae mainly dung-feeders.

This is a large subfamily, particularly well developed in the northern hemisphere but thinly represented here. Species of *Aphodius* are mostly associated with the dung of large herbivores and several European ones have been transported far and wide in cattle-ships, to become nearly cosmopolitan; *A. lividus* Ol. (3-5 mm), mostly light brown, but disc of pronotum and elytral sutures almost black is among those already established here. The shining, all-black *A. tasmaniae* Hope (10-12.5 mm) (Fig. 145), a common native species, is larger than most and is unusual also in that its larva is mainly a grass-feeder: it spends the day in a burrow and emerges at night to gather a

store of leaves for later consumption. These larvae are sometimes numerous enough to cause serious depletion of local pastures; the adults fly at dusk and often abound at lights.

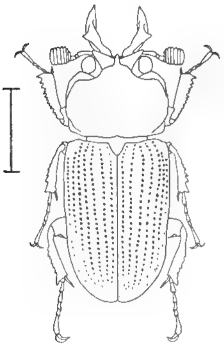
Subfamily SCARABAEINAE: dung beetles, small to medium-sized, convex to subspherical species; scutellum small or wanting; tip of abdomen exposed; front tibiae dentate for digging, with the tarsus sometimes lacking; colour always dark or metallic; larvae humped curl-grubs, feeding in buried dung masses, etc.

This subfamily includes the well known and time honoured Sacred Scarab of Egypt (*Scarabaeus sacer* L.) that featured constantly in the early folklore of that country. The beetle's diligence, purposefulness and apparent devotion to its dung-ball evidently caught the eye of the ancients and still amount to something of a star performance even today. A few of our native species have similar habits, notably the small, shining black *Diorygopyx* and the larger, dull black *Aulacopris* but most seem not to have developed such a sophisticated mode of nidification.

Aulacopris comprises two large and very rugose species that are attracted to human excrement: *maximus* Matthews (22-30 mm), southern Queensland and northern New South Wales; and *reichei* White (16-21 mm) (Fig. 152), southern New South Wales and eastern Victoria. Both species are able to fly but are nevertheless confined to the eastern coastal districts. By contrast, species of *Diorygopyx* are flightless and occur mainly in the wet forests of the Great Dividing Range, often with very localised distributions; there are at least seven species in our area. Details of the biology of these interesting beetles may be obtained, together with keys to genera and species, from the revision of Matthews (1974).

Species of *Cephalodesmius* may be recognised by the presence of prominent teeth on the clypeal margin of the head and a recent comprehensive study of their biology by Monteith and Storey (1981) confirmed that plant material is the primary food. This is gathered by the male and transported to a burrow, where the female processes it into food-balls for the young. *C. laticollis* Pasc. (13-19 mm) (Fig. 153) and *C. quadridens* Macl. (6-9 mm) are confined to the coastal forests of the Queensland-New South Wales border area but *C. armiger* Westw. (8-15 mm) ranges from there southwards to the Illawarra district.

Figs 141-149. Lucanidae and Scarabaeidae. (141) *Syndesus cornutus* F., ♂ (Lucanidae); (142) *Eucarteria floralis* Lea, ♀ (Lucanidae); (143) *Hoplogonus simsoni* Parry, ♂ (Lucanidae); 144-151 Scarabaeidae: (144) *Liparochrus silphoides* Har. (Hybosorinae); (145) *Aphodius tasmaniae* Hope (Aphodiinae); (146) *Onthophagus australis* Boisd. (Scarabaeinae); (147) *Phyllotocus rufipennis* Boisd. (Melolonthinae); (148) *Diphucephala smaragdula* Boisd. (Melolonthinae); (149) *Xylonychus eucalypti* Boisd. (Melolonthinae).



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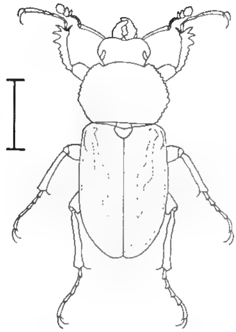

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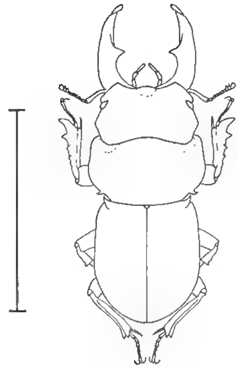

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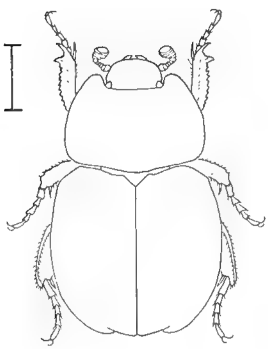

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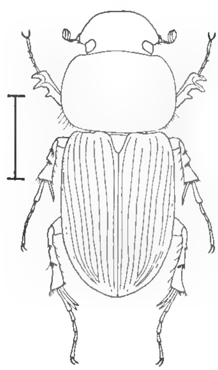

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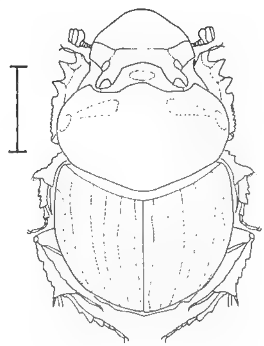

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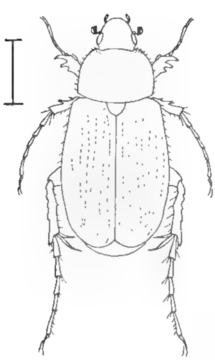

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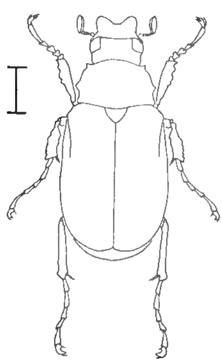

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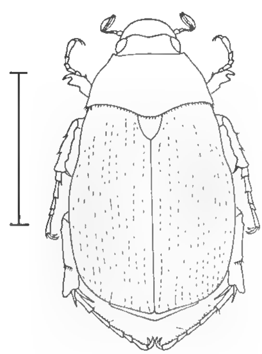

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Most of our scarabaeines belong to the cosmopolitan genus *Onthophagus*, of which *australis* Boisd. (10-12 mm) (Fig. 146) is one of the best known; it is dark bronze, with black legs and the male has two vertical, lance-like projections rising from the back of the head. This beetle is often plentiful about dung of domestic animals, as well as that of native marsupials. *O. declivis* Har. (14-15 mm), all-black, with the prothorax curiously bevelled (especially in the male), often flies to lights at night and the finer *O. pentacanthus* Har. (17-18 mm) (Fig. 140) may be taken occasionally in the same way. There are numerous smaller species of this genus in our area, some of which are also attracted to carrion. Matthews (1972) has revised the Australian forms.

Because our native Scarabaeidae are so adapted to dealing with the hard droppings of marsupials, they make very little impression on those of domestic animals. Thus every year, millions of tonnes of cattle dung litter our pastures and provide breeding-places for bush-flies and other noxious insects. To meet the problem, the C.S.I.R.O. is currently introducing exotic (mostly African) species that bury this material in large quantities and results in tropical Queensland, with *O. gazella* F., have been most encouraging; numerous other species, with differing climatic requirements, will be needed to cover the whole country.

Subfamily MELOLONTHINAE: Cockchafers–small to large, usually dull-coloured, reddish-brown; head and pronotum unarmed; legs slender but the front tibiae more or less dentate. The larvae are typical 'curl-grubs', feeding mostly upon grass roots or humus in the soil; many are pasture pests.

This is an enormous assemblage of obscure and mostly unattractive species of nocturnal habits but a number of the diurnal minority are metallic or otherwise brightly coloured. The difficulties of identification are such that beginners are best advised to confine their attentions to the diurnal forms, at least for their first few seasons. Their early captures are certain to include some of the exceedingly common *Phyllotocus* species that often swarm on native blossom and even on that of garden exotics (such as *Pyracantha*), which is shunned by most local beetles. The ochre-red and black *P. rufipennis* Boisd. (6.5-8.5 mm) (Fig. 147) is typical of this group but there are many other species. *P. macleayi* Fisch. (7-10 mm), ochre-yellow, the apical quarter to half of the elytra dark brown to black, is less strictly diurnal and often flies to lights in large numbers on warm midsummer nights. *P. bimaculatus* Er. is similar except that its elytra are mainly dark, with only a central pale spot on each; its flight season is a little later than that of *macleayi*, although the two species may sometimes occur together.

Diphucephala species will also be encountered early in the beginner's fieldwork. These are small flower chafers of a very uniform appearance and bright metallic green colour, although there are many species. *D. smaragdula* Boisd. (5-6 mm) (Fig. 148) was one of the first to be collected and described

and is common over most of the south-eastern States. *D. elegans* Blbn (6-7 mm) is a finer species that occurs at higher altitudes in the southern alps.

Although associated with foliage rather than flowers, species of *Xylonychus* appear to be diurnal. They are much larger than the above-mentioned forms and are usually encountered singly. *X. eucalypti* Boisd. (17-22 mm) (Fig. 149) is the best known of six species and is noteworthy for its unusual light, greenish-yellow colour in life, although this is often not well preserved in museum specimens: it is evidently widespread in New South Wales.

Readers wishing to identify the numerous nocturnal species of this subfamily should consult the works of Britton (1957, 1978, 1980).

Subfamily RUTELINAE: Christmas beetles–medium-sized to large, stout and generally metallic chafers; head and prothorax without prominences, but clypeus somewhat extended and reflexed in males; front tarsi weakly dentate; tarsal claws unequal, and apposable, to form a stout hook; larvae large 'curl-grubs', living mostly in the soil.

The largest genus is *Anoplognathus*, with many fine and brilliant species in our area. Unfortunately, however, the colours do not preserve well and mounted specimens of some species form little more than an apology for the living beetles, in the field. The adults fly both by day and by night and feed on eucalypt foliage, often stripping entirely certain favoured trees, season after season, until they succumb. *A. viridiaeneus* Don. (28-34 mm) is the finest local species and is brilliant metallic green in life, with bright red legs; it is strictly coastal in distribution and the larva is thought to feed on the roots of maritime grasses, etc. Formerly common about Sydney, where it earned the name 'King beetle', it is now becoming increasingly rare, owing to ever expanding urban development; it has, however, been recorded from as far north as Maryborough, Queensland. *A. montanus* Macl. (22-27 mm) (Fig. 154) of the tablelands, is similar but smaller and with a less brilliant sheen. *A. velutinus* Boisd. (21-27 mm) (Fig. 170), usually the first species to appear, is widespread but rather uncommon; it is a light brownish buff, with small dark spots and irregularly scattered whitish scales, giving a mealy appearance. The similarly coloured but bare *A. olivieri* Dalm. (23-30 mm) (Fig. 155) is quite common about Melbourne and Sydney later in the season. Readers wishing to identify their captures should consult Carne's (1958) revision.

Males of *Repsimus manicatus* Swartz (12-21 mm) are remarkable for the almost monstrous development of their hind tibiae, whereas those of *R. aeneus* F. (17-27 mm) are more normal in this regard. Both species vary in colour from dark bronzy-green to purplish-black; they are especially plentiful along the sandy banks of large rivers, where the adults feed on the foliage of sapling gums and tea-trees and the larvae burrow in the soil in search of roots and humus.

Subfamily DYNASTINAE: medium-sized to large, stout and heavy chafers, usually black or dark brown; male head and prothorax often bearing horns or tubercles, or grotesquely excavated; elytra not entirely covering the abdomen; front tibiae more or less dentate; tarsal claws equal and fixed; larvae stout curl-grubs, living in soil or decayed wood, etc.

This group includes the well known Rhinoceros beetles, of which one species (*Oryctes rhinoceros* L.) is an important pest of coconuts in the Pacific area, its larvae damaging the crowns of the plants. The Elephant Beetle, *Xylotrupes gideon* L. (28-58 mm) (Figs 156, 157), perhaps the most conspicuous Australian species, is widespread in the tropical regions of the country and extends southwards just about to our northern limits. As with most horned beetles, the male's ornamentations vary disproportionately with overall size, large beetles being well provided but smaller ones quite feebly so; females are unadorned.

Dasygnathus trituberculatus Blbn (15-33 mm) (Fig. 158) is one of the largest and most characteristic of the local species; it is a shining black beetle in which males show a curved and backward projecting horn on the head and two forward projecting prongs on the prothorax. Females are without these ornaments but with a sinuate groove behind the leading margin of the prothorax. The fore tibiae in both sexes are armed with stout teeth that give great purchase and the beetles are difficult to restrain with the fingers; they also stridulate loudly when handled.

Dasygnathus belongs to the section of the subfamily where the antennal lamellae are comparatively small and undeveloped; other local genera in this group include *Cheiroplatys, Novapus* and *Cryptodus.* In *Cheiroplatys bifossus* Blbn (20-27 mm) (Fig. 159), the legs are very stout, the teeth of the fore tibiae are quite blunt and sexual dimorphism is not well marked. The prothorax carries two shallow median depressions, one behind the other, and both stronger in males than in females. *Novapus* also shows blunt foretibial teeth and males of the species have a single cephalic horn and a deeply and broadly excavate prothorax; females are unadorned. *N. simplex* Sharp (16-24 mm) (Fig. 160) is one of two local species with a simple horn, whereas in *adelaidae* Blbn (19-24 mm), the horn is bifid.

Species of *Cryptodus* are very flat and the mouthparts and antennae (in repose) are protected by expansions of the mentum (lower lip); the species live in association with termites or ants. Most collectors will be familiar with

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Figs 150-160. Scarabaeidae. (150) *Elephastomus proboscideus* Schreib., ♂ (Geotrupinae); (151) *Blackburnium sloanei* Blbn, ♂ (Geotrupinae); (152) *Aulacopris reichei* White (Scarabaeinae); (153) *Cephalodesmius laticollis* Pasc. (Scarabaeinae); (154) *Anoplognathus montanus* Macl., ♂ (Rutelinae); (155) *A. olivieri* Dalm., ♀ (Rutelinae); (156) *Xylotrupes gideon* L., ♂ (Dynastinae); (157) *X. gideon*, ♀; (158) *Dasygnathus trituberculatus* Blbn, ♂ (Dynastinae); (159) *Cheiroplatys bifossus* Blbn (Dynastinae); (160) *Novapus simplex* Sharp, ♂ (Dynastinae). All approximately natural size.

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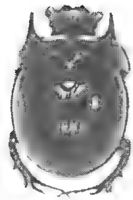

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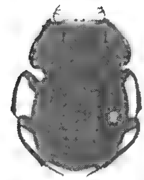

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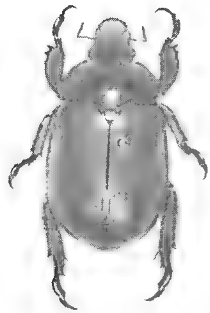

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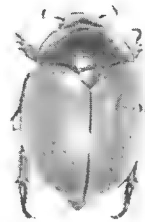

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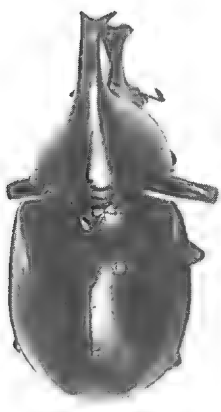

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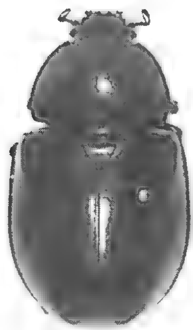

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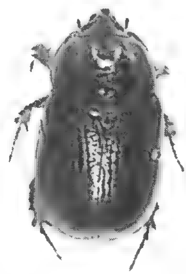

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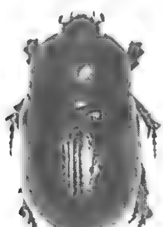

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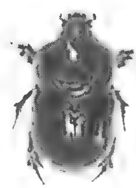

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these very sluggish beetles, which are generally taken from beneath fallen logs, although they also fly to light. The dull black *paradoxus* Macl. (17-21 mm) (Fig. 161) and the larger, shining black *tasmanianus* Westw. (22-28 mm) are common local examples.

Cryptoryctes includes light brown species, where the antennal lamellae are very long (especially in males). These are insects of the dry inland plains that border our western limits; males have forked cephalic horns, with three points in *trifidus* Blbn (14-23 mm) and two in *tectus* Blbn (17-22 mm). The prothorax in both species carries two long, upstanding prongs.

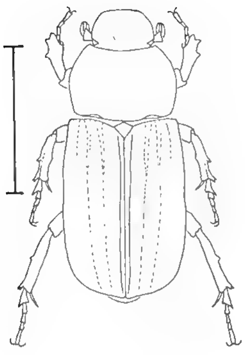
Two introduced exotic species are now established in well watered areas of the south-eastern States; these are the South African *Heteronyx arator* F. (11-16 mm) (African black beetle or Black lawn-scarab), all shining black, and the South American *Cyclocephala signaticollis* Burm. (12-16 mm) (Fig. 162), light brown with variable small, black flecks. The latter is one of the few members of the whole subfamily to show distinct markings and is of a lighter build than most dynastines.

The Australian Dynastinae were revised by Carne (1957).

Subfamily CETONIINAE: Rose chafers–medium-sized to large, flattened chafers of characteristic form; front tibiae dentate but only weakly so in most males; elytra truncate, leaving the tip of the abdomen exposed, and with the epipleura incomplete, exposing the sides of the meso- and metathorax and abdomen. The antennal lamellae are often longer in males than in corresponding females. Larvae stout and very hairy, less curved than in most other Scarabaeidae, living in leaf-mould, humus or very rotten wood.

These are mostly brightly coloured diurnal chafers that feed on nectar, pollen, or sometimes on whole flowers. Their common name is derived from certain European species that consume the stamens from wild or cultivated roses, but our species, which include some most attractive and conspicuous beetles, are mostly seen visiting native blossom. The characteristic 'cut' of the elytra allows the insects to fly with these organs unraised, thus greatly reducing wing resistance. Flight in cetoniines is therefore very strong and direct, in contrast to that of most beetles, and much time is spent on the wing, in search of blossom or oviposition sites. The species are most numerous in the wet forests of tropical Queensland but the group is represented in all eastern States except, apparently, Tasmania.

Figs 161-169. Scarabaeidae. (161) *Cryptodus paradoxus* Macl. (Dynastinae); (162) *Cyclocephala signaticollis* Burm. (Dynastinae); (163) *Diaphonia gulosa* Janson (Cetoniinae); (164) *D. olliffiana* (Cetoniinae); (165) *D. palmata* Schaum (Cetoniinae); (166) *Lyraphora bassi* White (Cetoniinae); (167) *L. obliquata* Westw. (Cetoniinae); (168) *Clithria eucnemis* Burm. (Cetoniinae); (169) *Glyciphana brunnipes* Kirby (Cetoniinae).



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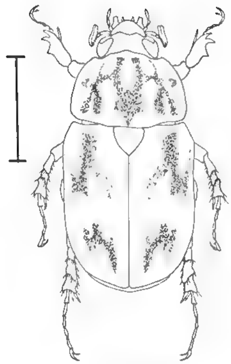

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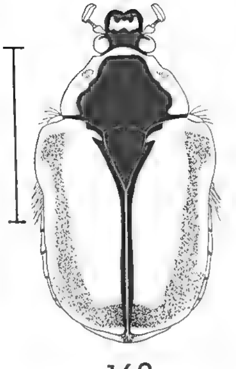

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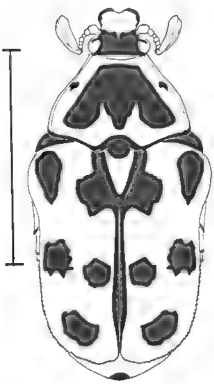

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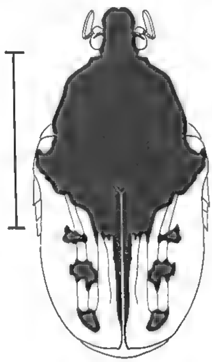

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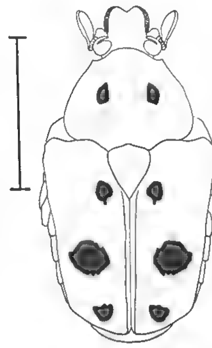

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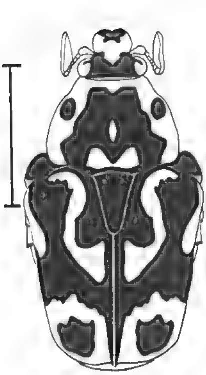

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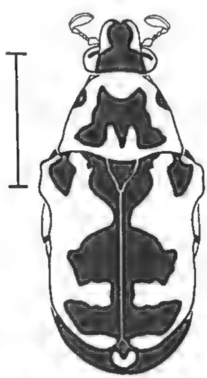

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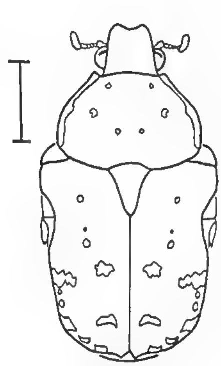

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The Fiddler Beetle, *Eupoecila australasiae* Don. (16-21 mm) (Pl. I, A), shining greenish-black, with bright yellow hieroglyphics, is a common and well-known visitor to *Angophora*, *Eucalyptus* and other bloom over the whole of our region; its larva is exceptional in feeding on rather dry but very weathered wood. *Polystigma punctatum* Don. (13-19 mm) (Pl. II, D), with its polka-dot pattern on an ochre ground, is equally common and readily identified. *Chlorobapta frontalis* Don. (17-24 mm) (Pl. II, E) resembles the Fiddler Beetle in size and markings but the elytral hieroglyphics are generally green. The larvae of this widespread species feed on the matrix of termite mounds and of termite workings in hollow but living trees, especially eucalypts. *C. besti* Westw. (20-25 mm) (Pl. II, F), also distinctively marked, ranges from E. Gippsland in Victoria to southern New South Wales and the A.C.T. Males of all species in this genus have dense, brush-like hairs on the hind tibiae.

Species of *Diaphonia* are less brightly coloured, in black and reddish-brown, but are nonetheless handsome enough: *D. dorsalis* Don. (22-30 mm) (Pl. II, G) is very widespread and is often attracted to garden compost heaps, where its larvae will develop if undisturbed. The adult beetles are seldom observed on flowers but are reported to attack ripe peaches and apricots. *D. gulosa* Janson (20-26 mm) (Fig. 163), largely chestnut-brown, is common in tall forests from Melbourne to the Snowy mountains and the A.C.T. and may be netted as it flies swiftly along shady tracks in high summer. The distinctively spotted *D. olliffiana* Janson (26-30 mm) (Fig. 164) appears to be restricted to eastern coastal districts of New South Wales. *D. palmata* Schaum (20-26 mm) (Fig. 165) is also normally spotted but its dark markings are sometimes greatly reduced; it ranges from New England northwards to the tropics. *Micropoecila cincta* Don. (20-23 mm) is rather like a small edition of *D. dorsalis* but is much more smooth and shiny; the adult beetle is most often seen on blossom in early summer and has a curiously discontinuous distribution, in eastern New South Wales and in south-western Australia. The larva has been found in the trunks of dead Grass Trees (*Xanthorrhoea*) and this may be the factor that limits its distribution.

The four known species of *Lyraphora* are largely tropical but two of them extend southwards to central New South Wales: *bassi* White (19-21 mm) (Fig. 166), pellucid golden brown, with black spots; *obliquata* Westw. (15-22 mm) (Fig. 167), black with yellow hieroglyphics, or sometimes largely pale, with black spots. *Schizorrhina* Kirby, a genus once encompassing most of the Australian Cetoniinae, is now restricted to one species, *atropunctata* Kirby (25-29 mm) (Pl. II, H), remarkable for its pale green colour in life, usually relieved with a few small black dots (except in var. *immaculata* Lea). The larva feeds in rich forest humus and the species ranges from central New South Wales to the rain-forest of north Queensland.

Species of *Trichaulax* may be recognised by their grooved elytra with associated bands of dense, shaggy pubescence; they are best represented in Queensland but *T. philipsi* Schreib. (22-34 mm) occurs widely in the southern

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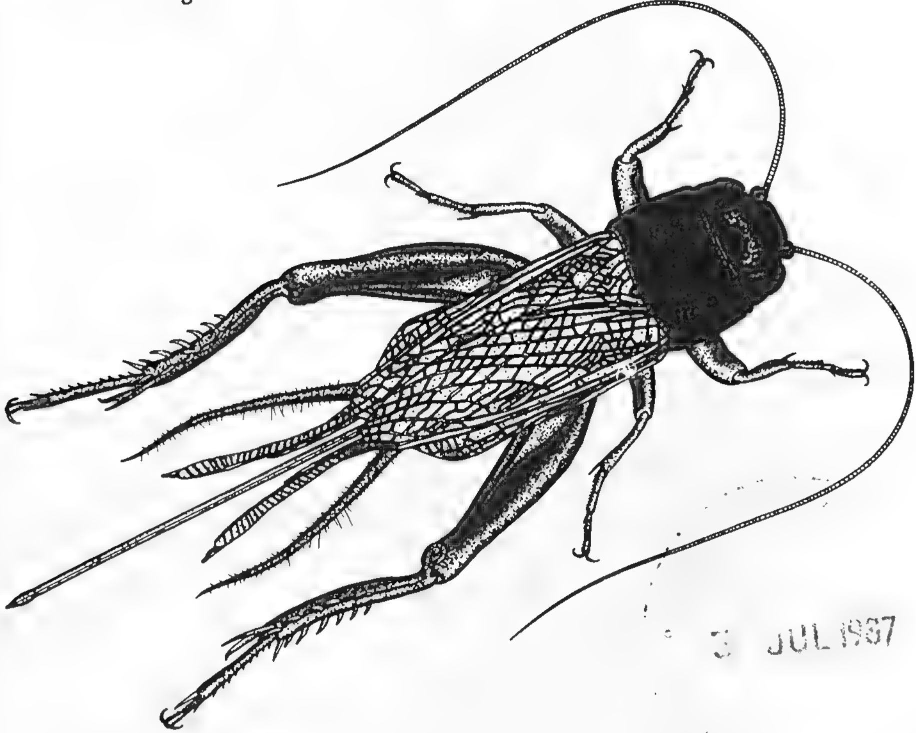

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COVER

Illustrated by Alan Westcott.

Black field cricket, *Teleogryllus commodus* (Walker). This native Australian insect is sometimes a serious pest of pastures and crops in Victoria, New South Wales and New Zealand. Damage is caused by adults and late stage nymphs chewing on leaves and stems of young plants at night. Plagues originate in grasslands and pastures, the crickets swarming at dusk during warm, calm weather.

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A NEW SPECIES OF *HETEROCONIS* ENDERLEIN (NEUROPTERA, CONIOPTERYGIDAE) FROM WESTERN AUSTRALIA

By T. R. New

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Abstract

Heteroconis argylensis sp. n. is described from the Kununurra area of Western Australia.

Introduction

Heteroconis Enderlein is one of the most diverse and characteristic genera of Coniopterygidae in the Australian region (Meinander 1969, 1972). Little attention has been paid to the Australian taxa since Meinander's (1972) revision, although additional species have been described from New Guinea (Tjeder 1973, New in press) and Indonesia (Monserrat 1982).

A small collection of Neuroptera made around the Argyle Diamond Mine in north-west Australia by Mr A. Postle contains a single male of a striking new species, which is described in this note. In general, Coniopterygidae attract little attention from collectors, and progressive documentation of the Australian fauna as material comes to hand is warranted. The same collection also contains two females of *Cryptoscenea evansorum* Smithers (1984), earlier known from Barrow Is. and south west Australia.

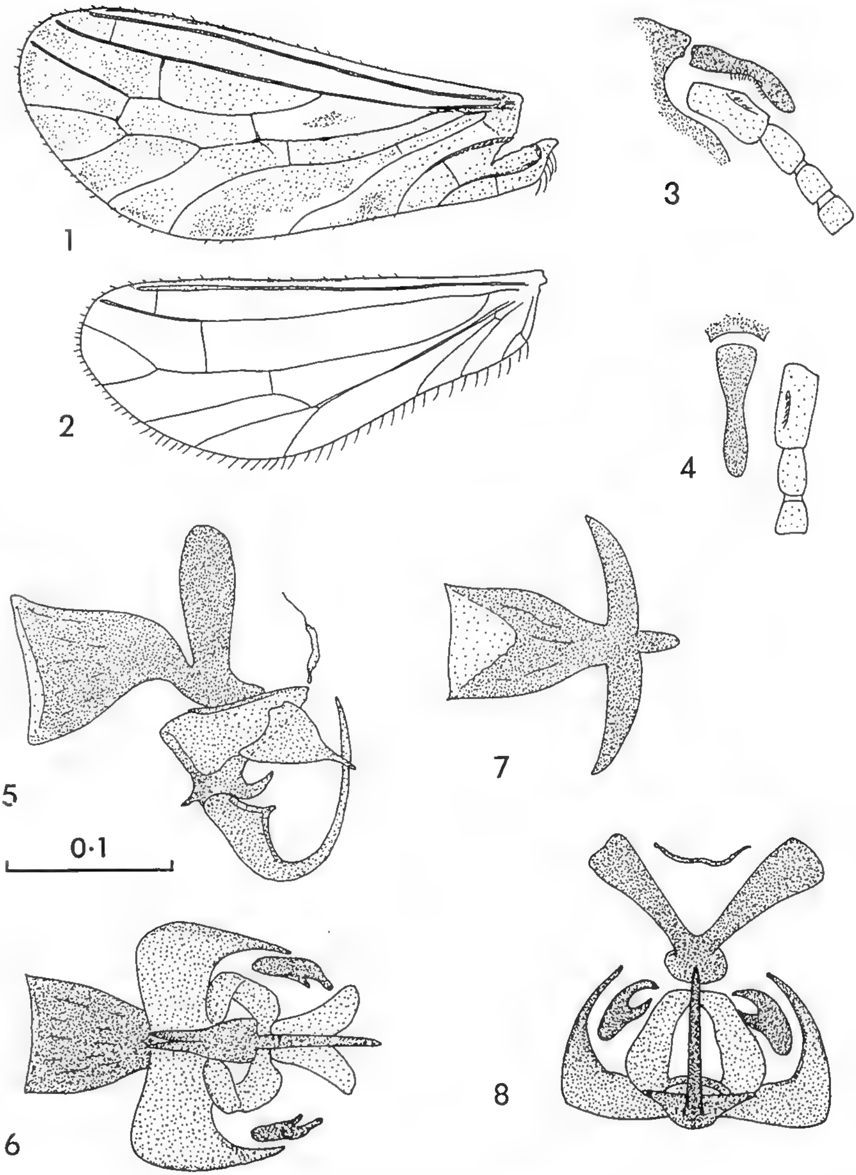
Genitalic terminology follows Tjeder (1973).

Heteroconis argylensis sp.n.

(Figs 1-8)

Type. Holotype, ♂, Western Australia, via Kununurra, Argyle Diamond Mine, 12.v.1985, A. Postle (Western Australian Museum, Perth).

Coloration (in alcohol). Head dark brown. Eyes black. Palpi and corniform process dark brown. Antennae: scape, pedicel, flagellum 1, 2 buff; flagellum 3, 4 darker brown, rest of flagellum dark brown. Thorax dorsally dark greyish brown, notal spots glossy and almost black; pleura greyish buff. Legs buff: F, apex of T, t_5 dark brown. Forewing (Fig. 1) marked with greyish brown, markings most contrasted near posterior margin, and more



Figs 1-8. *Heteroconis argylensis* sp.n., male: (1) forewing; (2) hindwing; (3) corniform process and base of antenna, lateral; (4) same, anterior; (5) internal genitalia, lateral; (6) same, ventral; (7) penis, dorsal; (8) genitalia, caudal. (Scale in mm).

anterior markings scarcely evident. Hindwing (Fig. 2) very slightly fumose; venation brown.

Morphology. Male with curved and centrally constricted corniform process bearing ventral short hairs (Figs 3, 4). Antennae relatively long; scape about twice as long as broad, with dorsal groove; pedicel nearly twice as long as broad; basal flagellar segment longer than broad, remaining segments quadrate or slightly broader than long. Legs normal, tibiae not expanded. Wings fairly narrow, venation as in Figs 1, 2; forewing basal R-M crossvein at second medial thickening; M-Cu crossvein between medial thickenings.

Male. Genitalia as in Figs 5-8; penis with strong dorsolateral lobes; gonarcus poorly defined; hypocauda slender, simple, strongly curved dorsally; gonocoxites broad and posteriorly tapered; styli hooked; parma weakly sclerotised.

Female. Unknown.

Measurement. Forewing 2.1 mm, hindwing 1.9 mm, A 1.1 mm, B 2.2 mm.

Comments. Genitalic features clearly differentiate this species from all described *Heteroconis* spp. Several Australian species with marked wings have the forewing M-Cu crossvein between the medial thickenings and a long slender hypocauda, and *H. argylensis* is probably most closely related to *H. enderleini* Meinander, *H. nigricornis* Meinander, *H. planifrontalis* Meinander and *H. varia* Enderlein. Of these, only *H. planifrontalis* has a R-M crossvein close to the second medial thickening, and this species is known from a single male from the Katherine area of the Northern Territory. *H. planifrontalis* lacks a corniform process, and *H. argylensis* differs from it also by having unornamented central flagellar segments and in numerous details of genitalic structure. The hypocauda of *H. enderleini* and *H. nigricornis* is apically furcate, whereas that of *H. planifrontalis* is simple as in the present species.

Acknowledgement

I am very grateful to Mr A. Postle for the opportunity to examine Neuroptera collected in Western Australia.

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A NEW SPECIES OF *MESODINA* MEYRICK FROM THE NORTHERN TERRITORY (LEPIDOPTERA: HESPERIIDAE)

By E. D. Edwards

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Abstract

Mesodina gracillima sp. n. is described from the Northern Territory. Adults and the male and female genitalia are figured and compared with the other species of *Mesodina* Meyrick. The status of *M. cyanophracta* Lower stat. rev. is discussed.

Introduction

In 1933 Mr T. G. Campbell collected a female specimen, closely resembling *Mesodina halyzia* (Hewitson), at Fort Dundas, Melville Island, Northern Territory. The specimen was sent to Dr G. A. Waterhouse who, in his subsequent publications, made no reference to it and no doubt believed that the locality, distant from any previously known locality, required confirmation. He may also have known that botanists at that time were unaware that a species of *Patersonia* (Iridaceae), the foodplant of other species of *Mesodina*, occurred in the Northern Territory. Between 1968 and 1970 F. and W. Omer-Cooper obtained four further specimens from the area between Oenpelli and the Blyth River. Three of these and the Campbell specimen were recorded by Peters (1969) who incorrectly sexed two of them. Since then larvae have been found and two further adults have been reared. Specht and Mountford (1958) mentioned the rediscovery of *Patersonia macrantha* Benth. in the Northern Territory and explained how the type locality of the plant was incorrectly recorded as Western Australia. Since then the plant has been recorded many times in the area where the *Mesodina* specimens have been taken (Geerink 1974).

Specimens of *Mesodina* from the Northern Territory are superficially very similar to specimens of *M. halyzia* from south-eastern Australia. Common and Waterhouse (1981) considered that they may represent a separate subspecies. However, the genitalia in both sexes show marked differences from *M. halyzia*, sufficient to indicate that the Northern Territory population is a separate species. This has prompted a reconsideration of the status of *M. halyzia* var. *cyanophracta* Lower. Waterhouse and Lyell (1914) and subsequent authors treated it as a subspecies of *M. halyzia* but Lower (1911) foreshadowed that its status may need to be reconsidered in the future.

Key to the species of *Mesodina* Meyrick

1. Underside of fore wing with large orange patch in cell extending almost to base . . . . *aeluropis* Meyrick
— Underside of fore wing without large orange patch in cell 2
2. Underside of hind wing bluish grey . . . . *cyanophracta* Lower stat. rev.
— Underside of hind wing reddish grey 3

3. Male fore wing almost always without small subapical spots above . . . . *halyzia* (Hewitson)
— Male fore wing with one or two small subapical spots above (in the two males known) . . . . *gracillima* sp. n.

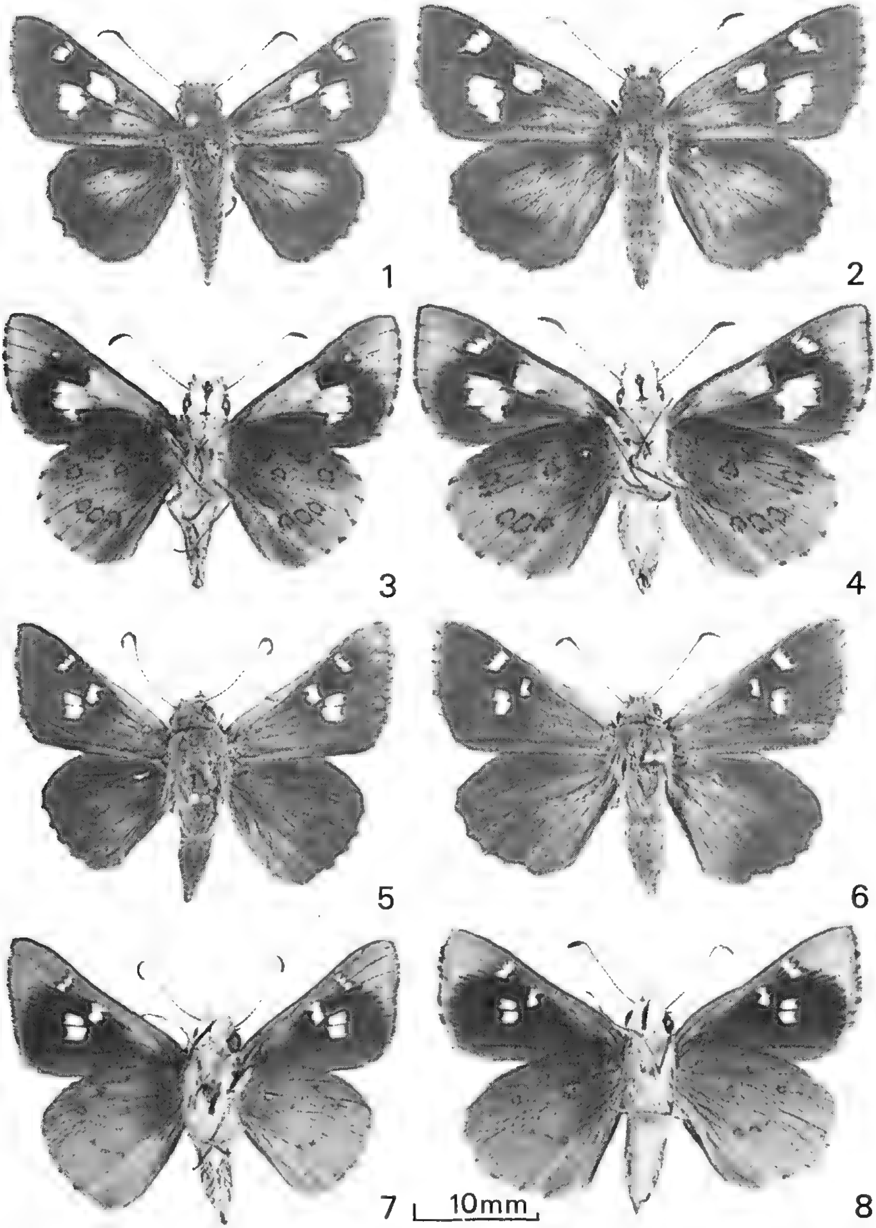
Mesodina gracillima sp. n.
(Figs 13-16, 20, 24)

Types:–*Holotype* ♂ labelled "12.18S 133.17E 15 km SW by S of Nimbuwah Rock, N.T. Emg 13 Jun 1973 E. D. Edwards and M. S. Upton Genitalia Slide M582 Reg. No. 3320", in Australian National Insect Collection. 1 ♂, 5 ♀♀ *paratypes*: 1 ♂ "Maningrida, N.T. 1/8 August 1968 F. Omer-Cooper"; 1 ♀ "Cadell-Blyth R. area N.T. 7.10.1968 F. Omer-Cooper"; 1 ♀ "Fort Dundas, Melville Island N.T. 3 Oct 1933 T. G. Campbell KL 09818 G. A. Waterhouse Collection"; 1 ♀ "Maningrida, N.T. 25/31 July 1968 F. Omer-Cooper"; 1 ♀ "10 mi. NE of Oenpelli, N.T. 5 Dec 1970 W. Omer-Cooper"; all in Australian Museum; 1 ♀ "13.20S 132.30E 16 km NE by N of UDP Falls N.T. Emg 6 July 1980 L. Craven, Larva coll 5 Jun 1980, spin web at shelter entrance 9 Jun 1980 from within Kakadu Nat. Pk. Larva in shelter on *Patersonia macrantha*" in Australian National Insect Collection.

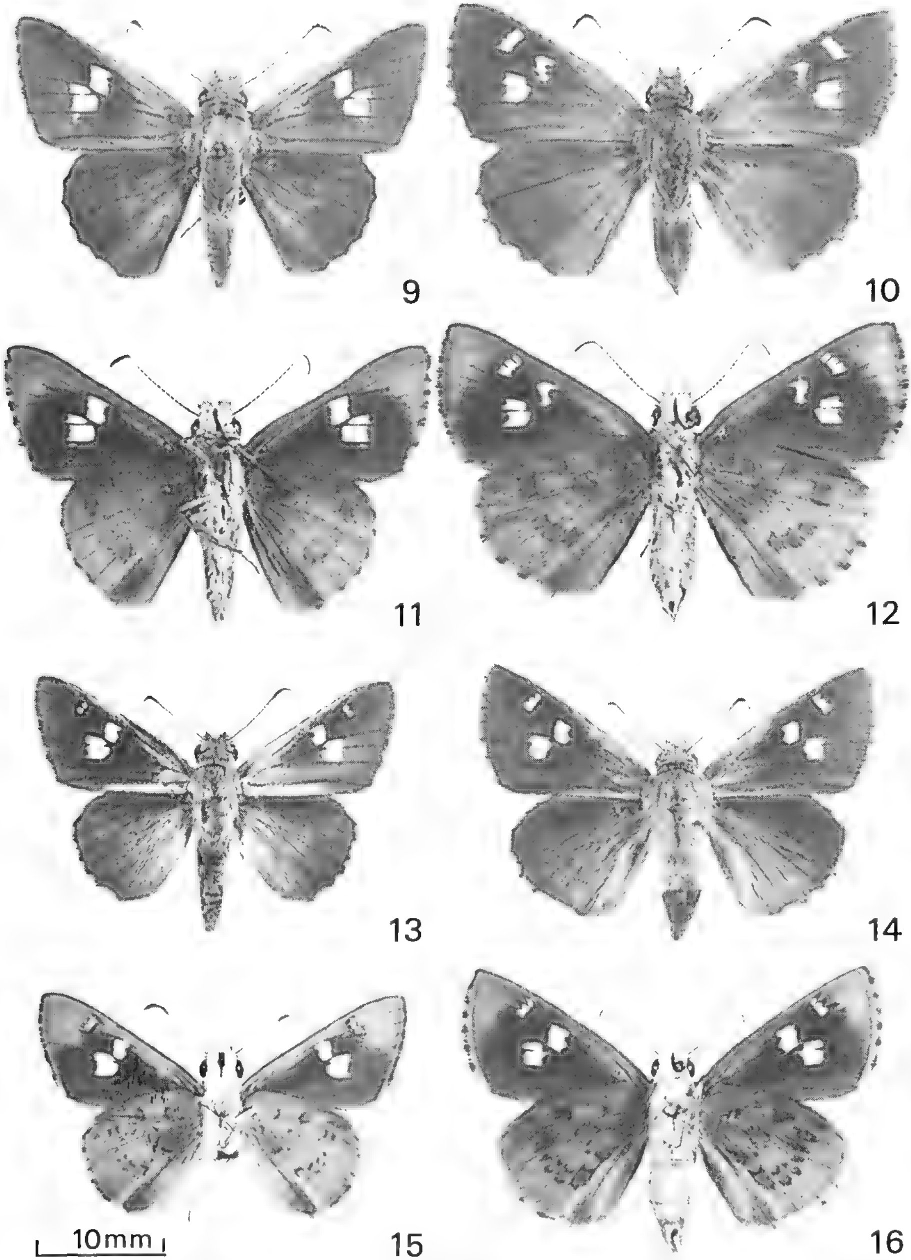
Distribution:–The species is known from Melville Island and in western Arnhem Land from the Blyth River area in the east to the Oenpelli area in the west and south to near UDP Falls.

Male (Figs 13,15):–Head reddish grey with some black scales, antennal shaft black above, pale yellow ringed with black beneath, apiculus blunt, black anteriorly, pale yellow posteriorly, nudum 15 segmented; labial palpus with second segment reddish grey above, white beneath, terminal segment brown. Thorax above grey, beneath white; legs pale reddish grey above, white beneath. Abdomen above grey, beneath white; legs pale reddish grey above, white beneath. Abdomen above grey, beneath white with reddish grey on sides. Fore wing costa almost straight, apex moderately pointed, termen almost straight; above dark brown with scattered pale grey scales towards base particularly along costa and dorsum; three large very pale yellow spots, one at end of cell, one between M_3 and CuA_1, one between CuA_1 and CuA_2, one or two small subapical very pale yellow spots; cilia pale grey, paler at tornus; beneath grey-brown, costa and apex reddish grey, spots as above, cilia grey brown, at tornus pale grey. Hind wing rounded, slightly truncate at tornus; above dark brown, some paler hair scales towards base, cilia pale grey; beneath reddish grey, two rows of reddish grey spots outlined in dark brown, one median the other submedian, anal area dark grey, paler proximally, cilia pale grey. Fore wing length 14 mm. *Genitalia* (Fig. 20). Combined tegumen and uncus long and slender terminating in a single down-curved tip; gnathos with fine spinules sparse and inconspicuous. Valva with ampulla well developed with truncate tip, harpe narrow, toothed, dorsal surface with toothed projection; saccus well developed. Aedeagus long and slender.

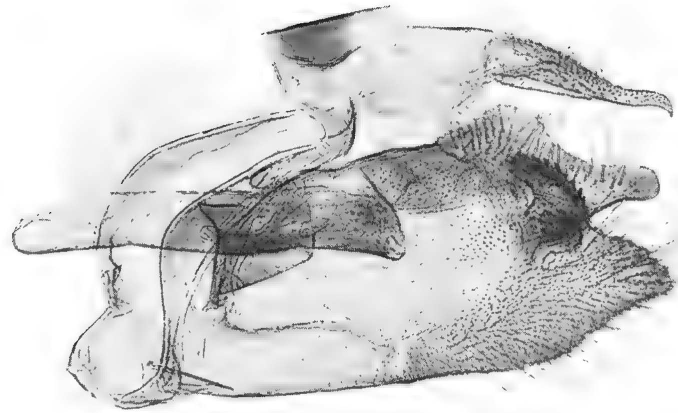
Female (Figs 14, 16).–Similar to male but fore wing with apex and termen more rounded, three subapical pale yellow spots. Fore wing length 14-16 mm.



Figs 1-8. Males odd numbers and females even numbers; upperside and underside: (1-4) *M. aeluropis*; (5-8) *M. cyanophracta* stat. rev.

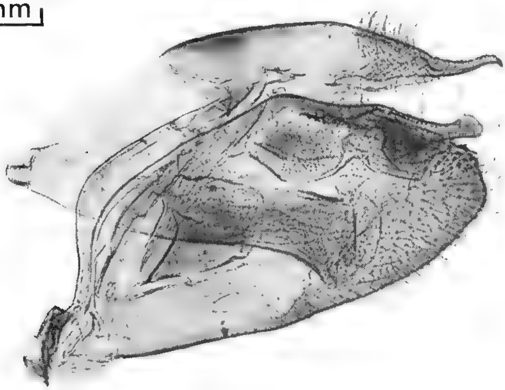


Figs 9-16. Males odd numbers and females even numbers; upperside and underside: (9-12) *M. halyzia*; (13-16) *M. gracillima* sp. n.



17

1mm



18

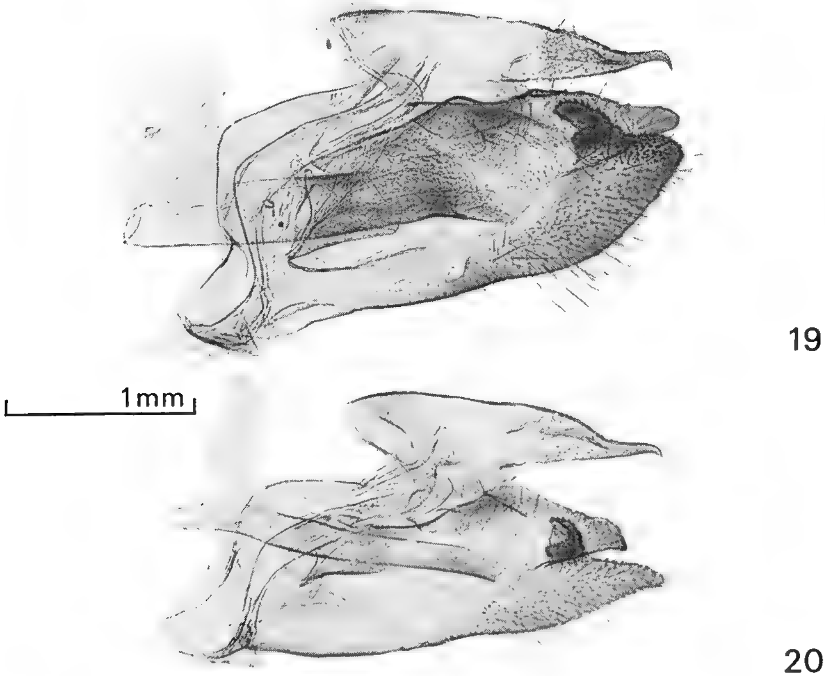
Figs 17, 18. Male genitalia with left valva removed: (17) *M. aeluropis* ANIC Slide M581; (18) *M. cyanophracta* stat. rev. ANIC Slide M572.

Genitalia (Fig. 24). Sterigma elongate, ductus bursae narrow, corpus bursae with long narrow posterior section, accessory pouch well developed.

Derivation:—The name *gracillima* is Latin for most slender, referring in particular to the aedeagus and the ductus bursae as well as the appearance of the adult.

Life History:—The species has been collected in June, July, August, October and December. Many larvae were found in late May but no adults were seen suggesting that few if any were flying at that time. However known localities are relatively inaccessible during the wet season from December to May and the dates may reflect this.

The early stages are very similar to those of *Mesodina halyzia* and *M. cyanophracta*. The larvae rest head downwards in shelters on the foodplant. Larvae have been found on the foodplant growing in flat terrain with deep,



Figs 19, 20. Male genitalia with left valva removed: (19) *M. halyzia* ANIC Slide M580; (20) *M. gracillima* sp. n. ANIC Slide M582.

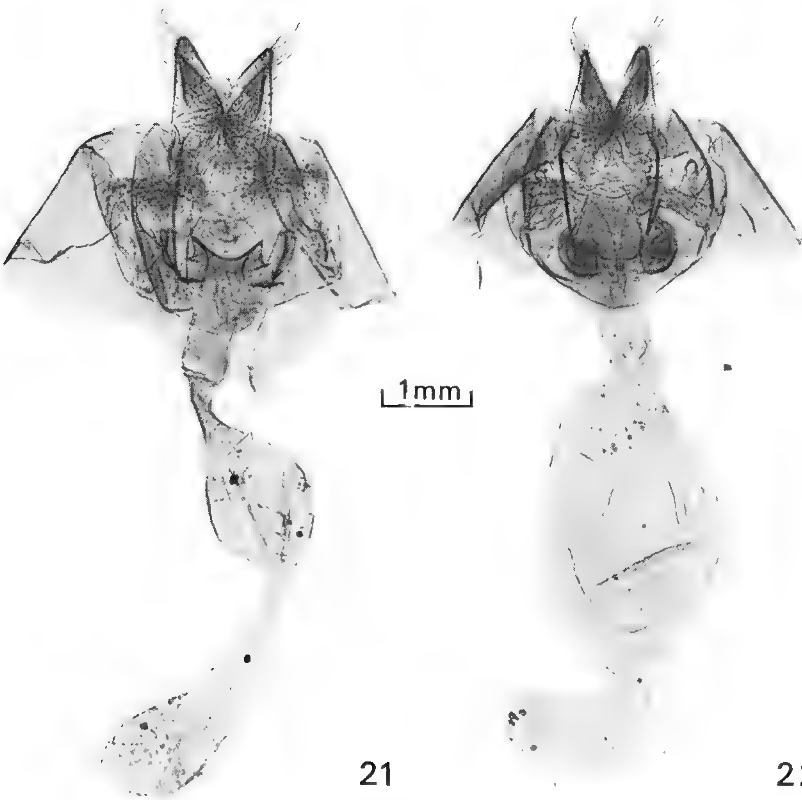
white sandy soil, apparently weathered from sandstones, supporting a *Eucalyptus* woodland with a sparse grass and herb understory.

Foodplant:–*Patersonia macrantha* Benth. (Iridaceae).

Discussion

Meyrick (1901) described the genus *Mesodina* to include the two species *M. halyzia* (Hewitson) (type species by original designation) and *M. aeluropis* Meyrick. Characters to distinguish *Mesodina* from other trapezitine genera are given by Edwards (1979).

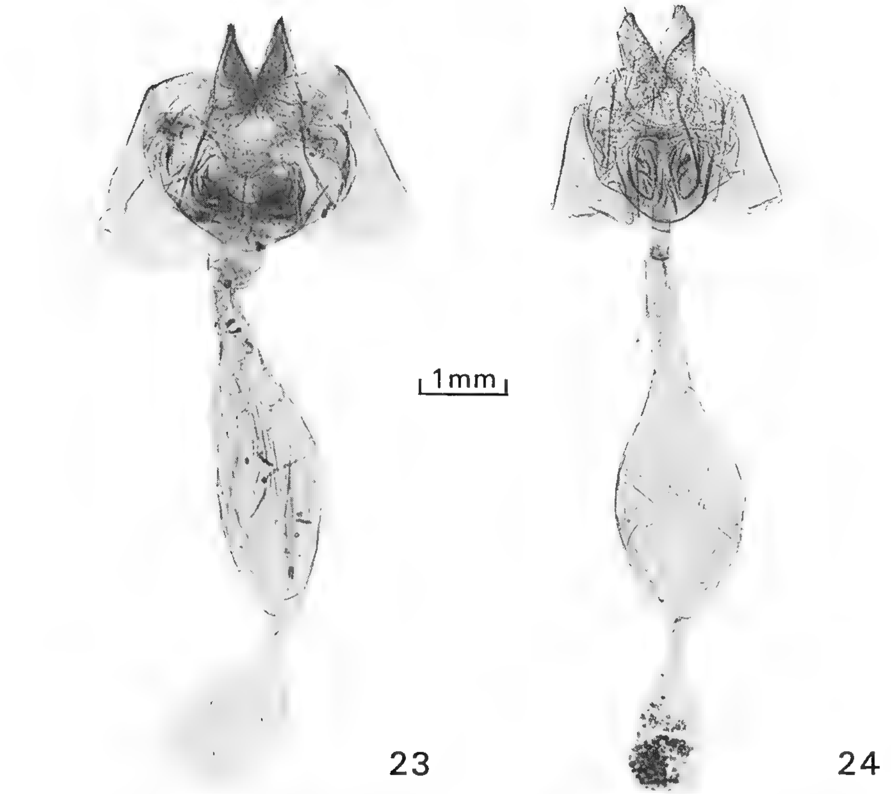
I have examined the holotype male of *M. halyzia* in the British Museum (Natural History). Waterhouse (1937) rejected the locality on the label of Port Denison (Bowen Q.) but the holotype represents the species from south-eastern Australia to which the name has been applied. Lower (1911) described *M. cyanophracta* from five specimens and a male was selected as the holotype by Waterhouse (1933). According to the International Code of Zoological Nomenclature this is a valid designation of a lectotype. There are two specimens labelled as from the type series in the South Australian Museum one is a



Figs 21, 22. Female genitalia: (21) *M. aeluropis* ANIC Slide M585; (22) *M. cyanophracta* stat. rev. ANIC Slide M583.

female and the other a male labelled "*Mesodina cyanophracta* Lower male TYPE Perth W.A. L3758" and on the reverse "N. B. Tindale Nov. 1948 replacing label destroyed by Wyatt". The male specimen has two other labels "Perth W.A." and "Passed through C. W. Wyatt theft coll. 1946-1947". As many specimens stolen by Wyatt had the labels removed there must remain some doubt as to the authenticity of the specimen. There is, however, no reason to doubt that *M. cyanophracta* is the correct name for the species from south-western Australia.

In adult males of *M. cyanophracta* and *M. aeluropis* (Figs 1, 3, 5, 7) three pale subapical spots are almost always present on the fore wing and almost always absent in *M. halyzia* (Figs 9, 11). The two males known of *M. gracillima* have one or two subapical spots. The colour of the underside of the hind wing in both sexes is grey in *M. aeluropis* with large well-marked spots (Figs 3, 4); bluish grey in *M. cyanophracta* with small poorly defined spots (Figs 7, 8) and reddish grey in both *M. halyzia* and *M. gracillima*. In



Figs 23, 24. Female genitalia: (23) *M. halyzia* ANIC Slide M587; (24) *M. gracillima* sp. n. Aust. Mus. Slide.

M. gracillima the spots are more distinct and the dark brown outline is better developed on the proximal margins of the spots (Figs 15, 16); the spot in the submedian row between veins CuA_2 and 1A+2A is distinct in *M. gracillima* and indistinct in *M. halyzia* (Figs 11, 12). The females of *M. aeluropis* are distinctive with large bright yellow fore wing spots (Fig. 2) while females of the other species are similar to one another on the upperside (Figs 6, 10, 14) but *M. cyanophracta* is distinctively coloured beneath. The hind wings of *M. halyzia* and *M. gracillima* are similar in shape but those of *M. cyanophracta* and *M. aeluropis* are slightly more rounded at the tornus.

The terminal segment of the labial palpus of *M. gracillima* and *M. cyanophracta* is slightly shorter than in *M. halyzia* and *M. aeluropis.* The nudum of the antenna contains 15 segments in *M. gracillima*; 15-16 in *M. cyanophracta*; 15-17 in *M. halyzia* and 16-17 in *M. aeluropis*. The tip of the apiculus is blunter in *M. cyanophracta* and *M. gracillima* than in *M. halyzia* and *M. aeluropis.* The base of the terminal segment in the apiculus is

about half as broad as the broadest segment in the former two species and less than half as broad in the latter two species.

M. gracillima is smaller than the other species; the fore wing length in each of the two males is 14 mm. Males of *M. halyzia* average about 15-16 mm; *M. cyanophracta* average about 15 mm but some are smaller and *M. aeluropis* average about 17 mm.

The male genitalia of *M. gracillima* differ markedly from those of the other species of *Mesodina* (Figs 17-20). The aedeagus is much narrower, the valva is narrower, the harpe is narrow and relatively pointed and the ventral margin of the valva is almost straight. In the female genitalia the sterigma is differently arranged, the ductus bursae is much narrower and the posterior half of the corpus bursae is narrow compared with the other species of *Mesodina* (Figs 21-24).

The genitalia of both sexes of all four taxa show marked differences and these differences are as marked as the differences in genitalia between *M. halyzia* and *M. aeluropis.* The genitalia of *M. gracillima,* in particular, differ so markedly from those of *M. halyzia* that it must be considered a separate species. To continue to regard *M. cyanophracta* as a subspecies of *M. halyzia,* when in some characters it differs more from *M. halyzia* than *M. gracillima* does, seems untenable and it should be considered a separate species.

Acknowledgements

I thank Mr L. Craven, CSIRO Division of Plant Industry, for a larva, Dr C.N. Smithers of the Australian Museum for the loan of specimens, Mr A. Atkins for kindly providing photographs of specimens in the British Museum (Natural History) and for comments, and Mr J. Green for the photographs. I also thank Dr E. S. Nielsen, Dr M. Horak and Dr I. F. B. Common for comments.

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REDESCRIPTION AND GENERIC POSITION OF *PSOCUS STRIATIFRONS* McLACHLAN (PSOCOPTERA: PSOCIDAE)

By C. N. Smithers

The Australian Museum, College Street, Sydney

Abstract

Psocus striatifrons McLachlan is redescribed after examination of the type specimen and transferred to *Tanystigma* Smithers.

Introduction

McLachlan (1866, p. 351) described *Psocus striatifrons* from "Australia meridionali". This was one of the earliest species of Psocoptera to be described from Australia. In a postscript to the same paper (*loc. cit.*, p. 352) he transferred it to *Stenopsocus* Hagan.

Stenopsocus is of mainly Palaearctic and Indo-Malayan distribution with one species occurring from West Irian, through Papua New Guinea, to northern New South Wales. Despite fairly extensive collecting in southern Australia the genus has not been found and some doubts arose as to the correct generic position of *S. striatifrons.* Brief examination of the type, a female, in the Hope Department, Oxford, confirmed that it was a member of the Psocidae and not one of the Stenopsocidae. Through the courtesy of Mr Ivor Lansbury I have been able to borrow the type for closer study. The results are presented here.

The type specimen was pinned on a micropin through card attached to a standard insect pin. Labels attached to the pin are as follows:—

1. A small white label, hand written, bearing the words "S. Australia". (Note: not "Australia meridionali" as in McLachlan 1866).
2. A blue diamond-shaped label with W in black ink.
3. A blue label with hand written "Psocus striatifrons McL".
4. A white label with narrow red border, with printed words "TYPE" and "Coll. Hope Oxon." and hand written "Trans. Ent. Soc. 1866, p. 351".
5. A large black bordered label with printed words "TYPE" and "HOPE DEPT. OXFORD." and hand written "Psocus striatifrons M'Lachlan."

The specimen has now been removed from the pin, using detergent, dissected and mounted on a slide to which the same labels have been glued.

Condition of type.—The type was in fairly good condition. It lacked antennae, except for the scape and pedicel of the right side. The distal part of the right fore wing was missing and the left fore wing damaged. The right eye and the subgenital plate were missing.

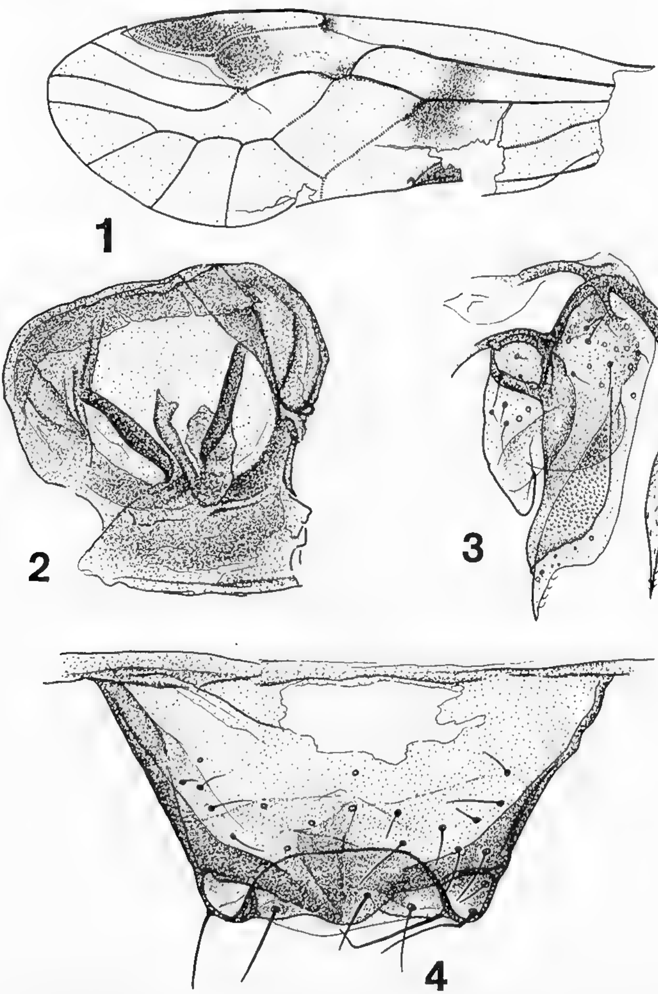
Redescription of the type of *Psocus striatifrons* McLachlan

Female

Coloration.—As described by McLachlan (1966 p. 351).

Morphology.—Length of body not measurable owing to collapsed state of abdomen. Median epicranial suture very distinct, anterior arms evanescent.

Postclypeus very well developed and strongly bulbous. Eyes fairly small, not reaching level of vertex. IO/D (Badonnel): 3.1: PO: 0.75. Anterior ocellus much smaller and more ovoid than lateral ocelli. Measurements of hind leg: F: 0.55 mm.: T: 1.15 mm.: t_1 : 0.27 mm.: t_2 : 0.15 mm.: rt: 1.7: 1: ct: 21, 0. Ctenidiobothria very small, poorly developed. Fore wing venation (Fig. 1). Pterostigmal spurvein well developed, fine, not reaching Rs. Cu_{1a} fused with M for a length. Fore wing length: 3.0 mm: width: 1.2 mm. Fore wing (Fig. 1). Epiproct (Fig. 4). Gonapophyses (Fig. 3). Subgenital plate missing. Ninth sternite sclerification (Fig. 2).



Figs 1-4. *Tanystigma striatifrons* (McLachlan), ♀ (1) left fore wing; (2) ninth sternite; (3) gonapophyses; (4) epiproct.

Discussion

Position of *Psocus striatifrons*

Hagen (1866) distinguished *Stenopsocus* from *Psocus* on the basis of the presence of a pterostigmal spurvein in *Stenopsocus.* He did not include the presence of a crossvein between Cu_{1a} and M in his characters for the genus. The distinguishing features were indicated in a key and the one feature he gave was sufficient to make the distinction clear. Genitalic features were not, at that time, used in generic definitions. McLachlan, when describing *P. striatifrons*, took the pterostigmal spurvein to be longer than it is. This is an understandable error as the fairly extensive postpterostigmal mark obscures the extent of the spurvein unless the specimen is examined with special care. As it is, venational features alone establish the specimen as belonging to the Psocidae not the Stenopsocidae. The form of the genitalia confirms this position. In the Stenopsocidae the females have reduced gonopophyses of relatively simple form.

Within the Psocidae the species falls within the definition of *Tanystigma* Smithers and is very similar to other species in the genus. *Tanystigma* (Smithers, 1983) is characterized by a combination of the following features: Rs and M fused for a length in fore wing: pterostigmal spurvein present: pterostigma elongate, relatively narrow and concave basad of spurvein; first section of Cu_{1a} longer than second and at an angle to it; external valve of gonapophyses lobed; subgenital plate with short lobe and divergent scleritized bands. Most of these features can be seen in the type of *P. striatifrons.*

Tanystigma is known only from Australia. *Tanystigma striatifrons* **(comb. nov.)** can be distinguished from the other species as follows. It is smaller than *T. dubium* (New) and *T. bifurcata* Smithers which both have a fore wing length greater than 4 mm and more extensive wing markings. *T. dubium* and *T. bifurcata* have a distinct dark area near the wing margin between R_1 and R_{2+3}. The sclerification of the ninth sternite is distinctive. *T. edwardsi* (New) has entirely hyaline wings except for the dark pterostigma which is very long and narrow with a poorly developed hind angle. *T. elongata* Smithers has very extensive wing markings, especially in the distal part of the fore wing where they occupy most of the cells anterior to M. *T. inglewoodense* (New) is larger (fore wing length 3.9 mm.) than *T. striatifrons* and the wing markings are a little more extensive; the mark which borders Rs and M fusion is particularly well developed. In *T. latimentula* (Smithers) the wings are hyaline and in *T. paulum* (Smithers) the female fore wing has the transverse band reduced to a patch basad of the separation of M and Cu and a mark basad of the nodulus. *T. paulum* is also larger (fore wing 4.0 mm.). Both *T. notialis* (Smithers) and *T. tardipes* (Edwards) are very much larger (fore wings 4.8 mm.).

The species of *Tanystigma* can be distinguished by the following key. Identification should be checked by reference to the original descriptions, especially those of the genitalia which show useful differences in proportions which are not easily expressed in a key.

Key to species of *Tanystigma*

1.	Fore wing membrane hyaline except for pterostigma and postpterostigmal mark	2
–	Fore wing with at least some markings in addition to pterostigma and postpterostigmal mark	4
2.	Fore wing longer than 4.5 mm	*edwardsi*
–	Fore wing shorter than 4.5 mm	3
3.	Male phallosome with parameres almost straight (male only known)	*latimentula*
–	Male phallosome with parameres strongly incurved	*paulum* (♂)
4.	Fore wing 3.0 mm long	*striatifrons*
–	Fore wing at least 3.9 mm	5
5.	Fore wing with at least a small dark area in cell R_1 near wing margin	6
–	Fore wing with cell R_1 near wing margin hyaline	8
6.	Fore wing with extensive dark markings in cells R_1, R_3, and R_5	*elongatum*
–	Fore wing with cell R_5 hyaline	7
7.	Fore wing with some shaded membrane at fusion of Rs and M	*dubium*
–	Fore wing without shading at fusion of Rs and M	*bifurcatum*
8.	Fore wing longer than 4.5 mm	9
–	Fore wing shorter than 4.5 mm	10
9.	Distal end of male parameres divided. Female subgenital plate lobe long and narrow, much longer than wide	*notialis*
–	Distal end of male parameres pointed. Female subgenital plate lobe short, as wide as long	*tardipes*
10.	Fore wing with dark shading around Rs and M fusion	*inglewoodense*
–	Fore wing without dark shading around Rs and M fusion	*paulum* (♀)

Conclusion

Examination of the type of *Psocus striatifrons* shows that the species should be transferred to *Tanystigma* and that it is distinct from other species of that genus.

Acknowledgements

I would like to thank Mr I. Lansbury for allowing me to borrow the type of *Ps. striatifrons* and Miss Barbara Duckworth for preparing the illustrations to this paper.

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THE SPECIFIC STATUS OF *PAUROPSALTA NIGRISTRIGA* GODING AND FROGGATT (HOMOPTERA: CICADIDAE) WITH THE DESCRIPTION OF AN ALLIED NEW SPECIES

By M. S. Moulds

Research Associate, Australian Museum, 6-8 College St., Sydney, N.S.W. 2000

Abstract

The Australian cicada *Pauropsalta nigristriga* Goding and Froggatt is distinct from *Pauropsalta melanopygia* (Germar) and is here removed from the synonomy of the latter. *P. infrasila* sp. n., a species from north-eastern Queensland and closely resembling *P. nigristriga*, is described.

Introduction

Ashton (1914) suggested that *Pauropsalta nigristriga* Goding and Froggatt, 1904, was a junior synonym of *Pauropsalta melanopygia* (Germar, 1834) and Burns (1957), followed by Duffels and van der Laan (1985), list it as such in their catalogues. However, the true identity of *P. melanopygia* has been uncertain as the type could not be found. Recently Dr A. Ewart and Mr I. Lansbury located the type of *P. melanopygia* (and other Australian cicada types of Germar) in the Hope Entomological Collections, University of Oxford, which Dr Ewart will discuss in a forthcoming paper (Ewart, in prep.). I have now examined the type of *melanopygia* (type locality Melville Island, Northern Territory) and it is clear that *P. melanopygia* and *P. nigristriga* are not synonymous.

P. nigristriga is usually an uncommon species which is often sympatric with a far more common cicada that is very similar in appearance; the latter, *P. infrasila* sp. n., is described below. Both species will be figured in colour by Moulds (in press).

The following abbreviations are used: AE private collection of Dr A. Ewart, Brisbane; AM Australian Museum, Sydney; ANIC Australian National Insect Collection, CSIRO, Canberra; BMNH British Museum (Natural History), London; JM private collection of Dr J. Moss, Brisbane; JO private collection of Mr J. Olive, Cairns; MM Macleay Museum, University of Sydney; MV Museum of Victoria, Melbourne; MSM author's collection; QM Queensland Museum, Brisbane.

Pauropsalta nigristriga Goding and Froggatt, 1904, stat. rev.

(Figs 1, 3, 4)

(Plate 9, figs 3, 3a in Moulds, in press)

Material examined.—NORTHERN QUEENSLAND: Holotype ♂, Endeavour River, no date, no collector (ANIC, on permanent loan from MM). 1 ♂, Annan River, Cooktown, 1905, Brown, ex W. W. Froggatt collection (ANIC, on permanent loan from MM). 1 ♂, 1 ♀, 24 km along Gunawarra road, S of Mt Garnet, 7.iii.1973, A. & M. Walford-Huggins,

(figured pl. 9, figs 3 and 3a 'Guide to Australian Cicadas'); 1 ♂, 1 ♀, Mt Molloy, 1.i.1974, A. & M. Walford-Huggins; 1 ♀, Clohesy River crossing, Mareeba-Kuranda road, 18.iii.1973, A. & M. Walford-Huggins; 1 ♂, 16 km S of Mt Molloy, 4.i.1974, A. & M. Walford-Huggins; 1 ♂, Davies Creek crossing, Mareeba-Kuranda road, 25.i.1976, A. & M. Walford-Huggins; 1 ♂, Annan River crossing, Grass Tree Pocket road, 8.i.1982, eucalypt-casuarina, G. & A. Daniels; 1 ♂, Laura River at old h'stead, 4.iv.1983, A. Walford-Huggins; 1 ♂, York Downs, 50 km E of Weipa, 28.xii.1983, M. S. & B. J. Moulds; 1 ♂, 10 km S of Woodstock, S of Townsville, 2.ii.1981, M. S. & B. J. Moulds; 1 ♂, Cairns, 24.i.1981, J. Olive (MSM). 5 ♂♂, 1 ♀, Kuranda, 12.ii.1950, 7/14.i.1950, 5.iii.1950, G.B. [George Brooks], ex A. N. Burns collection; 1 ♂, 1 ♀, Mowbray River, 9.iii.1952, G.B. [George Brooks], ex A. N. Burns collection; 1 ♂, Mareeba, 28.ii.1950, G.B. [George Brooks], ex A. N. Burns collection; 1 ♂, Mareeba, 3.xii.1950, J. G. Brooks, ex F. E. Wilson collection (MV). 1 ♂, 1 ♀, Tinaroo Lake, Atherton Tablelands, 20.xii.1981, J. Olive; 1 ♀, Clifton Beach, north of Cairns, 11.ii.1986, J. Olive (JO). 2 ♂♂, Mareeba, 31.xii.1950, J. G. Brooks; 1 ♂, Mt Molloy, Dr Riches, Exch. 1914; 2 ♂♂, Kuranda, 14,21.i.1951, J. G. Brooks; 1 ♀, Cairns, 1.i.1951, J. G. Brooks; 1 ♂, 32 km SW of Mount Garnet, 7.i.1976, D. K. McAlpine (AM). 7 ♂♂, 2 ♀♀, Station Creek, N of Mt Molloy, 4.iii.1981, J. Moss; 1 ♀, Ellis Beach, N of Cairns, 7.iii.1966, K. Norris (JM).

ADULT

Similar to *P. infrasila* sp. n. but differing as follows:–Rostrum reaches only to bases of hind coxae. Male abdomen below black at apex; genitalia (Figs 3,4) with pygofer produced laterally to form a large lobe angled ventrally on distal half or so. Female ovipositor sheath extending more than 2 mm (≈ 2.5-3.0 mm) beyond apex of abdomen.

HABITAT

Dry sclerophyll forest, often high up in eucalypt trees.

DISTRIBUTION (Fig. 1)

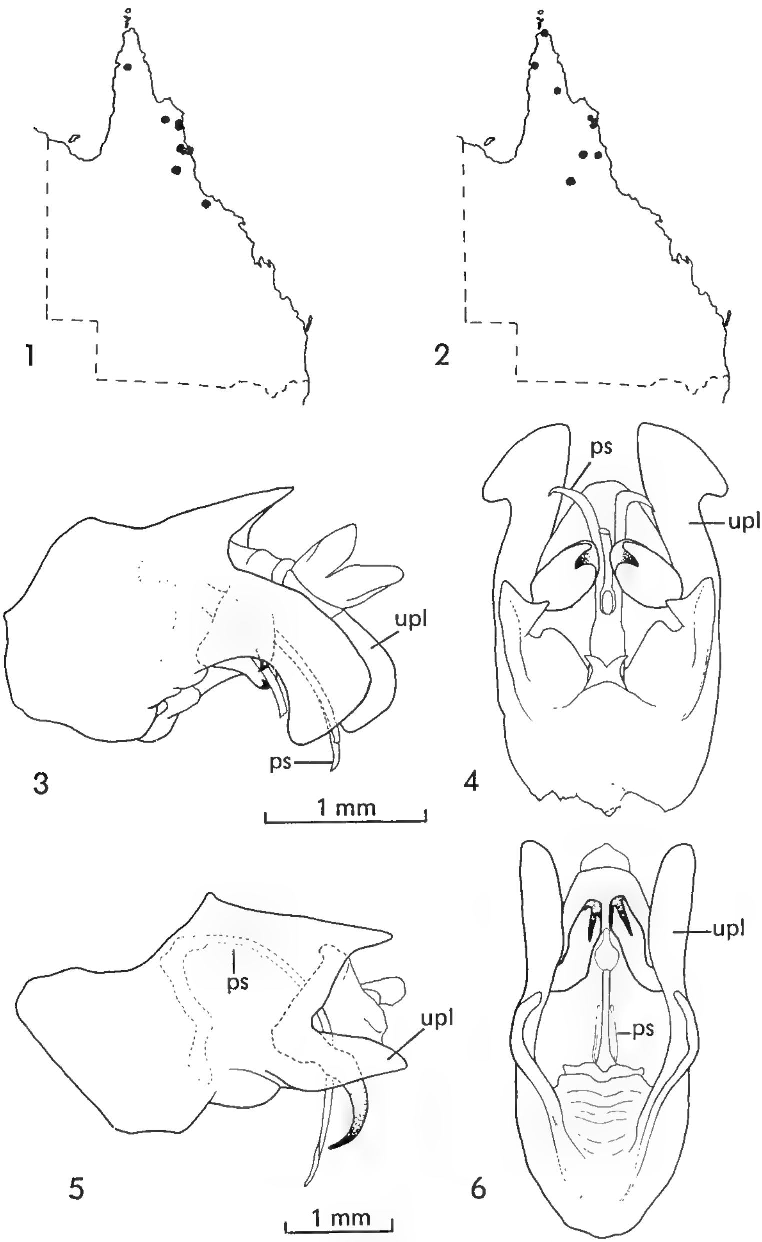
Northern Queensland south from "York Downs" near Weipa, through Laura, Cooktown, Cairns, Atherton Tablelands and Mount Garnet districts, to 50 km S of Townsville; usually uncommon. Adults have been taken from late December to early April.

Pauropsalta infrasila sp. n.

(Figs 2, 5, 6)

(Plate 9, figs 2, 2a in Moulds, in press)

Types.–NORTHERN QUEENSLAND: ♂ *holotype* and ♀ *allotype*, Isabella Falls, Bald Hills Stn [= Louisiana Stn], 30 km N of Cooktown, 13.ii.1982, M. S. & B. J. Moulds (AM). *Paratypes.*–2 ♀♀, Punsand Bay, Cape York, 17.i.1987, R. B. Lachlan; 1 ♂, same locality but 16.v.1986, R. B. Lachlan & M. R. Palfreyman; 1 ♂, Coen, 13.i.1964, M. S. Moulds; 9 ♂♂, 4 ♀♀, same data as holotype & allotype (1 ♂ figured pl. 9, fig. 2, 'Guide to Australian Cicadas'); 6 ♂♂, 4 ♀♀, swamp at head of Isabella Ck, 12 km N of Bald Hills homestead, 30 km N of Cooktown, 14.ii.1982 M. S. & B. J. Moulds; 1 ♂, Bald Hills Stn near turnoff to Laura, 3.i.1981, M. S. & B. J. Moulds; 1 ♂, 2 ♀♀, Bald Hills Stn, 4 km N of Isabella Falls, 29.xii.1984, G. & A. Daniels; 3 ♀♀, Bald Hills Stn, 8 km N of Isabella Ck crossing [= Isabella Falls], 9,13.i.1982, G. & A. Daniels; 1 ♀, Bald Hills Stn, 9 km N of Isabella Falls, 29.xii.1984, G. & A. Daniels; 1 ♂, 7 ♀♀, Cooktown, 17.ii.1982, M. S. & B. J. Moulds (1 ♀ figured pl. 9, fig. 2a 'Guide to Australian Cicadas'); 1 ♀, Mount Cook, Cooktown, 12.i.1982, G. & A. Daniels; 1 ♀, Mount Cook, Cooktown, 31.xii.1983, M. S.



Figs 1-6. (1) distribution of *P. nigristriga*; (2) distribution of *P. infrasila*; (3, 4) *P. nigristriga*, male pygofer in lateral and ventral views respectively; (5, 6) *P. infrasila* sp.n., male pygofer in lateral and ventral views respectively. ps, pseudoparamere; upl, upper pygofer lobe.

& B. J. Moulds; 1 ♂, Grassy Hill, Cooktown, 11.i.1982, G. & A. Daniels; 1 ♀, Annan River crossing, Grass Tree Pocket road, 7.i.1982, eucalypt-casuarina, G. & A. Daniels; 1 ♂, Wrotham Park via Chillagoe, 28.i.1978, R. I. Storey; 1 ♂, 2 ♀♀, 27 km E of Forsayth [near Georgetown], 24.xii.1977, R. I. Storey (MSM). 1 ♂, same data as holotype; 1 ♀, Cape Flattery road, via Cooktown, 29.x.1981, R. I. Storey & I. J. Titmarsh (DPIM). 1 ♂, 1 ♀, Claudie River, ♂ only bearing date 18.i.1914, J. A. Kershaw; 2 ♂♂, 8 ♀♀, Claudie River, ii.1914, Dr Macgillivray; 1 ♂, 1 ♀, Kuranda, i.1908, R. W. Armitage (MV). 6 ♂♂, 1 ♀, Grassy Hill lookout, Cooktown, 7.ii.1973, J. Moss; 1 ♀, Chillagoe, 28.i.1978, R. I. Storey (JM). 1 ♂, swamp at head of Isabella Ck, 12 km N of Bald Hills homestead [= Louisiana Stn], 30 km N of Cooktown, 14.ii.1982, M. S. & B. J. Moulds; 1 ♀ same data as holotype (AE). 1 ♂, 1 ♀, same data as holotype; 1 ♀, Hibberd Point, Weipa, 5-8.ii.1975, G. B. Monteith (QM). 1 ♂, 1 ♀, same data as holotype (BMNH). 1 ♂, 1 ♀, same data as holotype (ANIC). 1 ♀, Mt Cook nr Cooktown, 31.xii.1983, M. S. & B. J. Moulds (JO).

Other material examined.—2 ♂♂, 1 ♀, Claudie River, xi.1913-ii.1914, and 28.i.1914, J. A. Kershaw, all badly damaged (MV).

Adult

Male

Head.—Black with dull yellow markings. Postclypeus glossy black; most anterior part bearing a dull yellow spot; lateral margins dull yellow; dorsally depressed, almost flat; midline only weakly grooved but lateral transverse ridges distinct. Anteclypeus black. Rostrum brown at base becoming black towards apex; reaching just beyond apices of hind coxae. Antennae brown.

Thorax.—Pronotum brown with black and yellow markings. Anterior and lateral margins narrowly edged yellow, posterior margin much more broadly edged yellow, midline yellow except for a short distance at posterior end, a dull yellow spot either side of midline adjoining yellow posterior marginal band, black along pronotal grooves and either side of yellow dorsal midline. Mesonotum black with orange yellow markings; an orange-yellow marking on either side of midline extending from extremities of anterior arms of cruciform elevation to pronotum, these markings straight along their outer edge, greatly expanded inwards near centre on inner edge but the expansions never quite meeting; upper margin of each wing cavity orange-yellow, cruciform elevation orange-yellow; always a pair of small black dots, one against inner extremity of each anterior arm of cruciform elevation, these sometimes completely within the orange-yellow markings, but usually only adjoining the orange-yellow. Metathorax glossy black at hind wing base, remainder orange-yellow.

Legs.—Fore legs mostly brown with black markings, femora and tibiae pale yellow at their junction. Middle and hind legs more or less similar in colouring to fore legs but tibiae, and tarsae except for distal end, pale yellow.

Wings.—Hyaline; costa orange-brown; veins black; fore wing basal membrane brown, tending black; hind wing vein 2A weakly infuscated brown

with extensive brown plaga extending half to three quarters length of 3A.

Opercula.—Small; not closing tympanal cavities; widely separated; pale yellow and flat except for black, low, rounded swelling on basal quarter or so.

Tymbals.—Four long, black ribs spanning each tymbal and another spanning only about half, between each a very short rib; anterior edge black and strongly sclerotised.

Abdomen.—Brownish orange above and below; tergite 1 and anterior half of 2 essentially black; posterior edge of tergites 2-8 pale yellowish; anterior half or so of tergites 3-7 black but the black petering out laterally; tergite 8 substantially black. Sternite 2 essentially black, partly brown; forming a spine-like, glossy black projection separating tymbal and tympanum cavities; sternites 3-9 entirely without black pigmentation, sternite 3 broad, 8 very small.

Genitalia (Figs 5, 6).—Pygofer with upper pygofer lobes large, almost straight and tapering to a rounded point in lateral view; dorsal apical spine large. Uncus deeply bifurcate, the lobes long, slender, sickle-shaped in lateral view. Aedeagus long and slender, apex flanged; a ventral pair of delicate tubular pseudoparameres at base of shaft.

FEMALE

Similar to male but abdominal tergites with the black dominating except on tergite 8 which is almost entirely pale yellowish; abdominal segment 9 brown on anterior two thirds or so, pale yellowish on apical remainder, the brown bearing a dorsal pair of paramedian black fasciae that almost converge at their posterior ends. Ovipositor sheath extending about 1-1.5 mm beyond apex of abdomen.

MEASUREMENTS

Range and mean (in mm) for 20 ♂♂ and 20 ♀♀. Length of body: ♂ 19.9-24.0 (22.19), ♀ 19.8-24.4 (21.98). Length of fore wing: ♂ 23.6-30.5 (26.27); ♀ 24.0-29.3 (26.51). Width of head: ♂ 6.2-7.2 (6.62); ♀ 6.1-7.1 (6.68). Width of pronotum (max. at pronotal collar): ♂ 6.3-7.9 (7.07); ♀ 6.5-8.0 (7.24).

HABITAT

Open tropical bushland, in eucalypts and other trees.

DISTRIBUTION (Fig. 2)

Northern Queensland from Cape York, Weipa, Coen, Cooktown district, Atherton Tablelands, Chillago and 27 km E of Forsayth near Georgetown. It is usually a common species in the Cooktown district but there are few specimens from other areas. Most adults have been taken during January and February but there are records from late October to March and a single mid May record from Cape York.

Discussion

The close similarity in external morphology and coloration of these two species is not shared by the male genitalia. Male genital structure is, in fact, remarkably different in major characters (compare Figs 3 and 4 with 5 and 6), i.e. upper pygofer lobes (hypertrophied/simple), uncus (stout terminal spines/long and slender terminal spines) and aedeagus (a dorsal pair of very long pseudoparameres/a ventral pair of comparatively short and delicate pseudoparameres). Such differences, in two otherwise similar and partly sympatric species, must clearly separate these species biologically.

Acknowledgements

I am grateful to G. & A. Daniels, R. B. Lachlan, J. Olive, M. R. Palfreyman, R. I. Storey and A. & M. Walford-Huggins for collecting specimens on my behalf. The hospitality of Mr Mike Bredillet of Bald Hills Stn, where many of the new species were collected, is greatly appreciated. Dr J. Moss and Mr J. Olive also allowed me to examine material in their private collections and the curators of AM, ANIC, MM, and MV gave access to material in their care. For the loan of the type of *P. melanopygia* from Hope Entomological Collections I thank Mr I. Lansbury. Dr G. B. Monteith critically read the manuscript for which I am indeed appreciative. The Linnean Society of N.S.W. provided financial support by way of a Joyce W. Vickery Scientific Research Grant which is gratefully acknowledged.

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PSEUDOTAENIA WATERHOUSEI (V. d. POLL) (COLEOPTERA: BUPRESTIDAE) IN NEW SOUTH WALES

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Abstract

Earlier believed extinct in New South Wales, *Pseudotaenia waterhousei* is shown to be widespread and locally common in the interior of the State. The larval host in the southern part of the insect's range is *Acacia doratoxylon.* A summary of the recorded hosts of *Pseudotaenia* spp. is provided.

Introduction

Pseudotaenia Kerremans is one of nine genera of the buprestid subfamily Chalcophorinae currently recognized in the Australian fauna (Carter, 1929; Levey, 1978). Carter lists eight species of *Pseudotaenia*, limited in distribution to Queensland (five species) and Western Australia. They include the largest, and arguably some of the finest Australian species in the subfamily.

Unlike many other Australian Buprestidae, in particular members of the predominant genus *Stigmodera* and its allies, the Chalcophorinae are not known to feed on floral nectar as adults; rather, they frequent foliage, often of the larval hostplant. Recorded hosts of adult *Pseudotaenia* include tree species from several unrelated genera (Table 1). However, all known larval hosts are species of *Acacia* (Table 1).

No adult foodplant has been confirmed for *Ps. waterhousei* (V. d. Poll), and Hawkeswood (1983) suggested that adults may not feed at all. M. De Baar (cited by Hawkeswood, 1983) observed adults on lower trunks of the larval host *Acacia leiocalyx* at Dunmore State Forest in south-east Queensland. In central Queensland, Barnard (1890) described similar behaviour by the beetles on lancewood (*Acacia shirleyi*), suggesting that the latter species is the larval host there. Both *Acacia* spp. belong to the section Juliflorae (Pedley, 1978), and there are evident similarities in terms of habitat and growth habit between *A. leiocalyx* at Dunmore State Forest (Hawkeswood, 1983) and *A. shirleyi* further west and north (Groves, 1981). E. Adams of Edungalba, central Queensland (pers. comm., 1986) remembers hearing from H. Barnard that in January "from about 2 pm onwards [adults] come down the trunks of the trees on the shady side". Barnard "had taken as many as 50 . . . during one evening at 'Coomooboolaroo' near Duaringa". Adams considers that most were probably ovipositing females.

Occurrence of *Pseudotaenia waterhousei* in N.S.W.

Although Carter (1929) did not record the range of *Ps. waterhousei* as extending to N.S.W., Hawkeswood (1983) listed three "extremely old" specimens in the Australian National Insect Collection (ANIC) from Bimbi and Dubbo in the central west of the State. However, he considered the

species to have become extinct in N.S.W., citing the lack of recently collected specimens and the great changes that have occurred in the habitat since last century.

In fact, *Ps. waterhousei* continues to survive at discrete localities over a wide area of the western slopes of N.S.W. I have already noted several of these localities (Pullen, 1984); Fig. 1 shows places in N.S.W. where *Ps. waterhousei* is now either known or suspected to occur. The known localities are numbered as follows:—

1. Bimbi: 1 in ANIC (Hawkeswood, 1983).
2. Dubbo: 2 in ANIC (Hawkeswood, 1983).
3. Black Range, 16 km SW of Trundle: 1 in Australian Museum, Sydney, coll. 8 Jan. 1964 by B. Lowery.
4. Western foot of Weddin Mountains, near Grenfell (Fig. 2): on 13 Dec. 1981 the author and R. Pullen found adults emerging from trunks of living *Acacia doratoxylon* A. Cunn. (Mimosaceae) at a site just inside the boundary of the Weddin Mountains National Park and only about 13 km N of Bimbi (Pullen, 1984). A. Sundholm (pers. comm., 1985) subsequently (25 Dec. 1983) obtained a log billet from a heavily infested tree at the same site; 1 adult ♀ emerged the next day.
5. Round Hill Nature Reserve: examination by the author of *A. doratoxylon* trees on an isolated rocky hill in Nov. 1983 revealed numerous characteristic emergence holes and remains of an adult beetle.
6. Approximately 20 km NE of Kennebri: on 8 Apr. 1985, A. Sundholm (pers. comm., 1985) and J. Bugeja exposed a dead adult and several presumed larvae when cutting open "an *Acacia* sp., possibly *leiocalyx*".
7. Sandy Hollow: on 24 Oct. 1985 the author found remains of 1 adult in a tunnel in a fallen *Acacia doratoxylon*; numerous emergence holes typical of *Ps. waterhousei* were observed in many other *A. doratoxylon* trees.
8. Mt. Kaputar National Park: G. Williams (pers. comm., 1985) in Nov. 1985 found "quite a few" dead adults in dead trunks of *Acacia ?leiocalyx*; "one trunk, of *ca.* 11 cm width, had collapsed exposing 4 [dead] adults".
9. The Rock: 1 dead adult was taken from a gallery in a dead *A. doratoxylon* by the author on 28 Dec. 1985; several very fresh emergence holes of characteristic appearance were observed in another *A. doratoxylon.*
10. Near Bethungra: 2 dead adults were present in a dead *A. doratoxylon* tree examined by the author on 28 Dec. 1985; old emergence holes (Fig. 3) were present in other trees, although not commonly.

In addition, the author has observed characteristic emergence holes in trunks of *A. doratoxylon* at the following two localities, although no actual beetles could be found.

11. Monia Gap, Lachlan Range (Nov. 1983).
12. Western slopes of Warrumbungle Range (Oct. 1985). Here similar emergence holes were observed also in *Acacia cheelii* Blakely. Confirmation of this species as a host of *Ps. waterhousei* awaits the finding of adults or identifiable larvae.

No evidence of *Ps. waterhousei* was found in stands of *A. doratoxylon* examined at the following two sites:

13. Molonglo Gorge, near Queanbeyan (Jul. 1985).
14. Cromer Hills, near Holbrook (Dec. 1985).

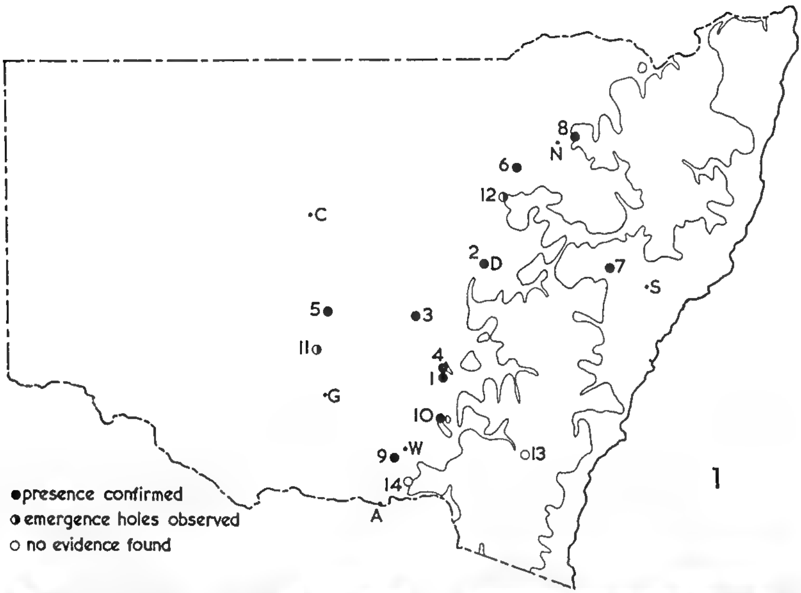

Fig. 1. Distribution of *Pseudotaenia waterhousei* in N.S.W. Great Dividing Range indicated by 500m contour. Towns shown: A, Albury; C, Cobar; D, Dubbo; G, Griffith; N, Narrabri; S, Singleton; W, Wagga Wagga. Refer to text for key to numbered localities.

Fig. 2. Stand of *Acacia doratoxylon* on western foot of Weddin Mountains.

Fig. 3. Presumed emergence holes of *Pseudotaenia waterhousei* in trunk of dead *Acacia doratoxylon*. Near Bethungra.

Discussion

Acacia doratoxylon, or "currawang", is widely distributed on the western slopes and plains of N.S.W., extending into north-eastern Victoria (Maslin & Pedley, 1982). The alternative common name of lancewood reappears among several given by Cunningham *et al.* (1981), and the species often forms dense, almost monospecific communities clearly similar to *A. shirleyi* communities described by Speck (1968) and Groves (1981) in Queensland.

Where extensive stands of *A. doratoxylon* remain, *Ps. waterhousei*, on the evidence of (presumed) emergence holes, would seem to be a common species. This is evidently the case at Monia Gap and at the Weddin Mountains, and probably on other residual escarpments in mid-western N.S.W. The existence of an apparently thriving population east of the Great Divide at Sandy Hollow is interesting, although perhaps not surprising in view of the strong "western" element in the flora and vegetation of the upper Hunter valley (Anderson, 1968). The Rock, at latitude 35.16S, remains the southernmost known locality of *Ps. waterhousei.* The northern slopes of the Cromer Hills near Holbrook are clothed in *A. doratoxylon*, but the absence of any sign of the beetle or of any emergence holes in numerous trees examined by me strongly suggests that the site is outside the range of *Ps. waterhousei.*

Acacia doratoxylon does not extend north beyond about 30°S latitude in northern N.S.W., where its range meets that of *A. leiocalyx* (Maslin & Pedley, 1982), the latter species being the only other confirmed host of *Ps. waterhousei* (see Table 1). Both A. Sundholm (pers. comm., 1985) and G. Williams (pers. comm., 1985), describing populations of *Ps. waterhousei* respectively near Kennebri (locality No. 6, above) and at Mt. Kaputar National Park (locality No. 8, above), tentatively identified the host as *A. leiocalyx*, and the transition to that host probably occurs in that area. *A. leiocalyx* in fact extends to the coast in northern N.S.W. and southern Queensland (Maslin & Pedley, 1982), although *Ps. waterhousei* appears confined to the western part of the host's range.

Hawkeswood (1983) expressed great concern about the continuing survival of *Ps. waterhousei.* However, the preference of its southern host *Acacia doratoxylon* for skeletal soils on rocky ridges and hillslopes (Costermans, 1981; Cunningham *et al.*, 1981) has ensured that extensive communities of the tree remain, even in places where the surrounding flat country was cleared for agriculture long ago. This fact, together with the known presence of the beetles in two national parks (Mt. Kaputar and Weddin Mountains) and two nature reserves (Round Hill and The Rock) should allay any fears for its survival in N.S.W. The 'lancewood' species of *Acacia* in Queensland occupy similar habitats, and *Ps. waterhousei* should be sought in such places.

TABLE 1
Recorded larval and adult host plants of *Pseudotaenia* species.

Sp. of *Pseudotaenia*	Recorded host	Family	Reference
ajax (Saund.)			
larva	brigalow (*Acacia harpophylla*)	Mimosaceae	Hobler (1925); Adams (1966)
adult	*Eucalyptus* sp., 'broad-leafed . . . a heavy gnarled tree'	Myrtaceae	Barnard (1890)
adult	blackbutt (= *Eucalyptus cambageana*: Perry, 1968)	Myrtaceae	Hobler (1925)
adult	coolibah (= *Eucalyptus microtheca*: Boland *at al.*, 1984)	Myrtaceae	Adams (1966)
adult	grey box (= *Eucalyptus moluccana*: Boland *et al.*, 1984)	Myrtaceae	Adams (1966)
quadrisignata (Saund.)			
adult	trees of 15-20cm diam. 'near the edge of the scrub'	?	Barnard (1890)
adult	red ash (= *Alphitonia excelsa*: Perry, 1968)	Rhamnaceae	Anonymous (undated)
adult	sarsaparilla (= *Alphitonia petriei*: Blake & Roff, 1972)	Rhamnaceae	Anonymous (undated)
salamandra (Thoms.)			
adult*	*Casuarina* sp.	Casuarinaceae	Barnard (1890)
spilota Cart.			
larva	*Acacia grasbyi*	Mimosaceae	Hawkeswood & Peterson (1982)
waterhousei (V. d. Poll)			
larva	*Acacia leiocalyx*	Mimosaceae	Hawkeswood (1983)
larva	*Acacia doratoxylon*	Mimosaceae	Pullen (1984)
adult (larva ?)†	lancewood (= *Acacia shirleyi*: Speck, 1968; Pedley, 1978)	Mimosaceae	Barnard (1890)

* as *Chalcophora vittata*
† as *Chalcophora superba* (= *Pseudotaenia superba*), a related species restricted a to W.A. (Carter, 1929)

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Dr J. F. Lawrence of the CSIRO Division of Entomology in Canberra and Mr G. A. Holloway of the Australian Museum, Sydney, kindly allowed access to collections in their care. Messrs E. E. Adams of Edungalba, A. M. Sundholm of Sydney and G. A. Williams of Lansdowne gave information freely. My father Mr Roy Pullen helped and shared in the rediscovery of *Ps. waterhousei* at the Weddin Mountains in 1981.

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NOTE ON AERIAL SWARMING OF *PERISSOMMA* (DIPTERA: PERISSOMMATIDAE)

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Abstract

Aerial swarming of males of *Perissomma mcalpinei* Colless is described.

Introduction

Flies of the family Perissommatidae were described for the first time in 1962, and almost all that is known about them is included in the two papers of Colless (1962; 1969). Some observations on living adults of *Perissomma fusca* Colless and larvae of *P. fusca* and *P. mcalpinei* Colless were recorded.

Field Observations

Observations on *Perissomma mcalpinei* were made near the scenic lookout at Mount York, Blue Mountains, New South Wales, at an altitude of 1070 m. This locality is 10 km as the crow flies SW of Mount Wilson, the type locality of the species. The habitat is dry sclerophyll forest on well drained rocky ground (sandstone) on a hill top at the termination of a range system. Nearby development includes a road, carpark, and walking tracks with a remnant of a flower garden.

The generalisation of Colless (1969) that *P. mcalpinei* lives naturally in rain forest and wet sclerophyll forest is not supported by this occurrence, as a true wet sclerophyll is at some distance and there is no rain forest in the vicinity. The habitat at Mount Boyce, Blue Mountains, where I swept a female of *P. mcalpinei* on 19.v.1967, is similar to that at Mount York.

The date of observation, 6.vii.1986, is at about the coldest time of year, the average temperature for July at nearby Mount Victoria being 5.4°C. This accords with collection dates for adults of *Perissomma* spp. in general given by Colless (1962; 1969), which are mostly in June and July, but at Mount Donna Buang, near Warburton, Victoria, I obtained 2 adults of *P. mcalpinei* on 8.iv.1963.

Numbers of these small, delicate flies were seen in mid afternoon on and near a plant of waratah (*Telopea speciosissima*, family Proteaceae) about 1 m high, and some also at an adjacent plant (? *Agapanthus* sp., family Alliaceae, not native). A few specimens were first observed singly in the sunlight on leaves or flying above them for some time. They were then observed also in small aerial swarms of 2 to about 5 flies just above these plants. Individuals in the swarms did not hover, but flew in a rather rapid zigzag path which made it slightly difficult to capture them with a pocket net of *c.* 15 cm diameter. Sometimes, after flying above a leaf for a little time, an individual would alight on it. One pair was seen *in copula* on a leaf. As the area fell into shade, activity of the flies ceased, but this could have been due to disturbance by the collectors.

The sample of 33 specimens of *P. mcalpinei* collected on this occasion included only 2 females. Many of these were taken from the flying swarms, which evidently consisted entirely or almost entirely of males. Male aerial swarms are known for Diptera of many families (Downs, 1969; Oldroyd, 1964) and generally are considered to signal the males' availability for mating.

The active, often sustained flight of *P. mcalpinei* contrasts with the flight behaviour of *P. fusca* as recorded by Colless 1962. He found them to be "extremely sluggish, to such an extent that, in the laboratory, they are most conveniently handled with forceps, like apterous insects. They rarely fly, even when disturbed, and the occasional short flight lasts for only a second or less . . .".

Acknowledgement

I am indebted to B. J. Marlow for assistance in collecting these insects.

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NEW RECORDS OF BUTTERFLIES (LEPIDOPTERA: PAPILIONOIDEA) FROM KANGAROO ISLAND, SOUTH AUSTRALIA

By R. P. Mayo

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Introduction

Kangaroo Island is a rich area for South Australian butterflies; Fisher (1985) records 24 species from this island out of a total of 64 known to occur in South Australia. During field work in late October and early November, 1985, I found two additional species for Kangaroo Island, bringing the total number of species now known to 26.

New records

NYMPHALIDAE

Vanessa itea (Fabricius)

A single specimen was sighted but not collected on 29 October, 1985, 10 km south of Penneshaw.

LYCAENIDAE

Theclinesthes miskini miskini (T. P. Lucas)

Two males were taken at American Beach on 1 November 1985. Both were flying rapidly around *Adriana klotzschii* on top of a sand dune in company with *T. albocincta*.

Reference

Fisher, R. H., 1985. Butterflies (Lepidoptera: Hesperioidea, Papilionoidea) of Kangaroo Island. *Aust. ent. Mag.* 12(1): 1-8.

ESCAPE BEHAVIOUR OF INSECTS ON FIRE-BLACKENED TREE TRUNKS IN EAST GIPPSLAND

By R. G. Piper*, G. A. Olden** and E. H. Traill†

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Abstract

Escape mechanisms of 44 insect species observed on fire-blackened tree trunks in dry sclerophyll forest at Granite Mountain, in East Gippsland are recorded.

Introduction

The dry sclerophyll forests of East Gippsland have always been subject to the influence of fires. These fires originally were the result of natural occurrences such as lightning strikes or the occasional use of fire by aborigines. Settlement by Europeans in these areas for the purpose of raising stock meant that the forests were burnt more often than before. It was found that an interval of five years between fires was optimal as it allowed for the accumulation of sufficient forest litter to ensure a successful burn. Forage growth was promoted by these fires and systematic forest burning became an established farming practice (McKinty 1969).

Current management practices used by the Victorian Forests Commission include the use of fuel reduction burning to an extent necessary to prevent the spread of large wildfires. These low intensity fires are carried out mostly during autumn, using either ground or aerial ignition techniques (Anonymous 1981).

We collected insects from fire-blackened tree trunks at two sites (1 and 2) at Granite Mountain, approximately 40 km north of Cann River in East Gippsland, Victoria from 3-16 January 1982. Both sites had experienced a fire nine months prior to our study.

Site 1 was a dry ridge top with a mixed dry sclerophyll forest predominantly consisting of *Eucalyptus sieberi* (silver top), but also including *Eucalyptus obliqua* (messmate), *Eucalyptus globoidea* (white stringybark) and *Eucalyptus fastigata* (cut tail).

Site 2 was an alluvial creek flat which also had a mixed dry sclerophyll forest. The main tree species were *E. globoidea* and *E. cypellocarpa.* Minor species present were *E. sieberi* and *Eucalyptus radiata* (narrow leaf peppermint).

Insects were collected from tree trunks either directly into glass vials with the aid of jewellers forceps or by means of a hoop net. Observations on escape mechanisms were noted prior to collection of each specimen. Specimens from this study have been deposited in the Museum of Victoria, except for ants which were deposited in the Australian National Insect Collection.

TABLE 1
Insects collected from fire-blackened tree trunks in East Gippsland

Order	Family	Genus & Species	No. collected	Escape mechanism*
Coleoptera	Carabidae	*Adelotopus haemorrhoidalis* Er.	1	D
		Promecoderus elegans Cast.	1	D
	Alleculidae	*Anaxo cylindricus* Germ.	1	A
		Tanychilus striatus Newm.	1	A
	Buprestidae	*Nascio vetusta* Bois.	1	A
	Cerambycidae	Undetermined	1	A
	Curculionidae	*Aterpus tuberculatus* Gyll.	1	B
		Cherrus sp.	2	A
		Rhinaria cultratus (F.)	1	A
		Tyrtaeosus sp.	1	A
	Elateridae	*Conoderus nitidulus* Cand.	1	A
	Lagriidae	*Lagria grandis* Gyll.	2	D
	Melyridae	*Carphurus triimpressus* Lea	1	D
Diptera	Tabanidae	*Cydistomyia victoriensis* (Ric.)	1	C
	Tachinidae	*Macropodexia longipes* Macquart	2	C
		Rutilia vivipara (F.)	1	C
		Senostoma sp.	1	C
	Asilidae	*Laphria rufifemorata* Macquart	2	C
		Neoitamus margitis (Walker)	10	C
		Neoitamus sp.	1	C
Lepidoptera	Psychidae	Undetermined (2 spp.)	3	F
Hemiptera	Achilidae	Undetermined (3 spp.)	3	D
	Cicadellidae	Undetermined	1	D
	Cicadidae	Undetermined	1	C
	Eurybrachyidae	*Platybrachys* sp.	1	D
	Lygaeidae	*Daerlac* sp.	2	D
	Pentatomidae	*Diemenia rubromarginata* (Guer.)	2	D
	Reduviidae	*Stenolemus edwardsii* (Bergr.)	1	E
Hymenoptera	Anthophoridae	*Exoneura* sp.	1	C
	Formicidae	*Camponotus* sp.	1	E
		Crematogaster sp.	1	E
		Iridomyrmex sp. (2 spp.)	4	E
		Myrmecia pilosula (Fr. Smith)	3	E
		Myrmecia sp. (2 spp.)	3	E
		Podomyrma sp.	1	E
		Polyrhachis sp. (2 spp.)	2	E
		Rhytidoponera tasmaniensis	1	E
Blattodea	Blattellidae	Undetermined	1	C

* A. Remaining stationary (often in crevices), relying on camouflage to avoid detection.
B. Becoming immobile (retracting legs) and dropping to the ground.
C. Taking flight.
D. Running and/or jumping across the bark surface.
E. Roving freely over the bark, relatively undisturbed by attempts at capture, but employing biting and/or stinging mechanisms upon capture.
F. Living within the protection of a web or case.

Results and discussion

Observations from sites 1 and 2 have been combined as the two collection sites were not sufficiently different from one another and this study too small to allow for valid comparisons to be made. A list of the species collected, along with escape mechanisms observed prior to capture of each specimen in given in Table 1.

The escape mechanisms listed in Table 1 give only a general indication of the ability of each species to avoid capture. A species may often rely on several different strategies in order to avoid predation.

Many of the species collected were black or dark brown in colour enabling them to blend with the fire-blackened bark. In addition, some of these species possessed spines and protuberances which further assisted in camouflaging them against the rough texture of the bark. A particularly striking example of this feature was seen in the weevil, *Aterpus tuberculatus.*

Adult asilids, tabanids and tachinids align their bodies vertically, often facing downwards when resting on the black trunks. This makes it even more difficult to distinguish the outlines of their black bodies against the vertical fissures of the bark. The orientation of these insects also assists in regulating body temperature. Dark insects have been shown to absorb more solar radiation than lighter coloured insects. By varying their body orientation these insects can control their body temperatures (Chapman 1975).

Daerlac sp. mimics ants of the genus *Camponotus* in body shape, colouration and movement, the latter which were also collected in this study,

The findings of this study suggest that many insects have successfully utilized the microhabitats provided by burnt tree trunks. It seems likely that predators such as birds would have played an important role in influencing these insects. Escape mechanisms amongst these insects vary greatly and in some instances a species may employ several mechanisms, resulting in increased protection.

Additional collecting from fire-blackened tree trunks will reveal the presence of many more species. Numerous microlepidopteran adults and spiders were observed during our study but were not collected due to difficulty in obtaining identifications.

Acknowledgements

For identification of specimens we are grateful to Dr A. Neboiss and Mr K. Walker (Museum of Victoria); Dr R. Taylor (CSIRO); Mr G. Daniels, Dr E. Exley and the late Dr T. Woodward (University of Queensland); and Dr B. Cantrell (Queensland Department of Primary Industries). Mr E. Ferguson (Victorian Forests Commission) kindly provided identification of the trees.

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THE LIFE HISTORY OF *YOMA SABINA PARVA* (BUTLER) (LEPIDOPTERA: NYMPHALIDAE: NYMPHALINAE)

By G. A. Wood
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Abstract

The life history of the Australian lurcher, *Yoma sabina parva* (Butler), is described and a larval foodplant listed.

Introduction

The Australian lurcher is distributed through the Northern Territory, the islands of Torres Strait, and Cape York to Cairns and the Atherton Tableland (Common and Waterhouse, 1981).

In an effort to discover its life history a female *Yoma sabina parva* was enclosed with various small herbaceous plants occuring in swampy areas. I had previously observed lurchers to frequent these situations apparently attracted to various succulent plants. The caged female subsequently oviposited and adults were raised on one of these plants.

Life history

Foodplant. Ruellia sp., Acanthaceae.

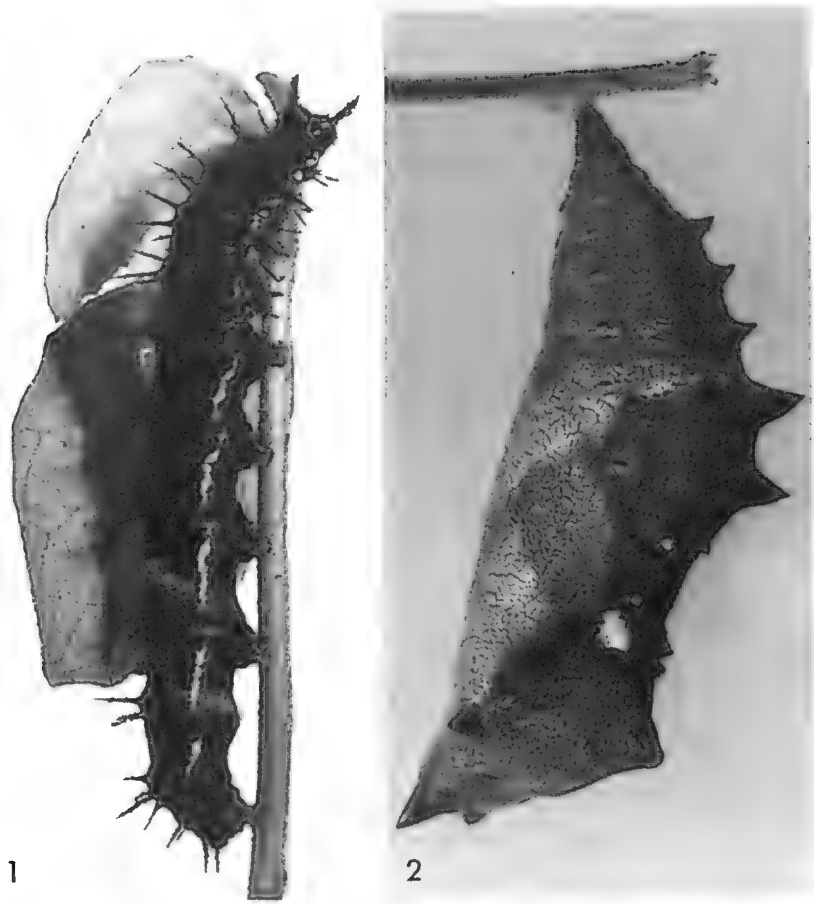
Egg. Diameter 1 mm. Shiny silver-green, smooth, spherical, with fine vertical ribs.

First instar. Length 2.5 mm. Head smooth, shiny black, rounded square in shape. Body green, turning yellow toward the posterior end, covered with long, forward curved, black hairs.

Third instar. Length 6 mm. Head the same as in first instar but with two spined, dorso-lateral horns. Body smooth, lustrous, black, except for prothorax, base and toward posterior end of body, which are orange. Each segment with four large branched spines, dorso-lateral and lateral.

Fifth instar (Fig. 1). Length 35 mm. Head as in third instar but with 1 mm long black hairs and spines on horns produced to filaments to 4 mm long. Body smooth, dull black, lateral spines with orange patches at their base, joined by a cream line. Prolegs brown. Body with pale white hairs 0.5 mm long.

Pupa (Fig. 2). Length 22 mm. Smooth, with a pair of lateral anterior projections, mesothoracic ridge pointed and with small dorsal projections on abdominal segments three to seven. Dorso-lateral projections on all segments, those on third and fourth abdominals largest. Mesothorax with two pair of large lateral projections, abdominal segments three and four with small lateral projections. Variable grey-brown, with projections on metathorax and abdominal segments one and two white, spiracles black. Suspended by cremaster.



Figs 1, 2. *Yoma sabina parva*: (1) fifth instar larva on foodplant; (2) pupa.

Notes. Eggs are laid singly underneath the leaves of the foodplant. Larva shelter beneath the leaves and feed day or night. The foodplant is small and the larva quickly strip it then move about in search of other plants. Pupation occurs on nearby vegetation.

The life cycle, commencing mid December, took thirty two days. Ova hatched in four days, the larval stage took twenty two days, and the pupal duration lasted eight days.

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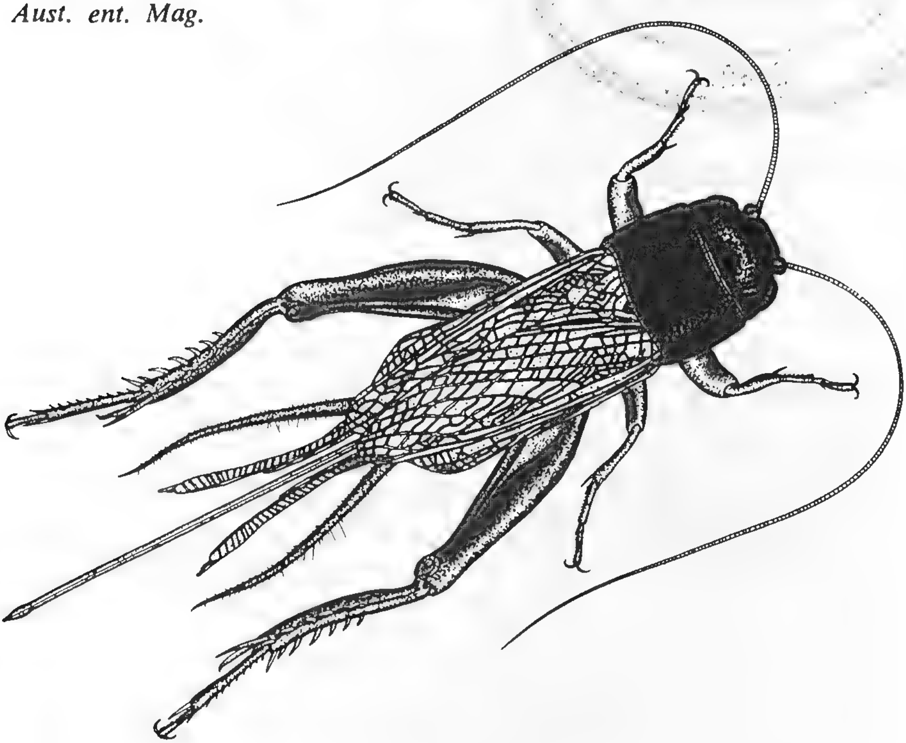

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COVER

Illustrated by Alan Westcott.

Black field cricket, *Teleogryllus commodus* (Walker). This native Australian insect is sometimes a serious pest of pastures and crops in Victoria, New South Wales and New Zealand. Damage is caused by adults and late stage nymphs chewing on leaves and stems of young plants at night. Plagues originate in grasslands and pastures, the crickets swarming at dusk during warm, calm weather.

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NOTES ON THE FEEDING HABITS OF BURROWING BUGS OF THE GENUS *ADRISA* (HETEROPTERA: CYDNIDAE)

By Ian Faithfull
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Abstract

Two species of Cydnidae, *Adrisa atra* Dallas and *A. erichsoni* Signoret, are recorded feeding on seeds of *Acacia* Mill. (Mimosaceae) for the first time.

Woodward, Evans and Eastop (1970) note that little is known of the habits of the Australian Cydnidae but "many are probably root feeders". Miller (1971) states that the food of the family is mainly the roots of plants and animal matter. Exceptions to the root feeding habit are species of the northern hemisphere genus *Sehirus* Amyot & Serville which feed on stems and seeds of plants of the family Labiatae (Woodward, 1949; Southwood and Hine, 1950; McDonald, 1968). Facultative blood sucking has been noted in *Geotomus pygmaeus* Dallas (Miller, 1971).

About 11 pm on 29 January 1983 adult specimens of *Adrisa atra* Dallas (family Cydnidae) were found in the litter under a planted *Acacia* tree 5 km south-east of Yanakie, Victoria. This was during a period of severe drought, the ground being very dry with little new vegetative growth. One of the bugs had its rostrum inserted in the hilum of the seed of the *Acacia*. The bug carried the seed with its rostrum still inserted and apparently by holding the seed with its mid legs. After about 20-30 s the insect disengaged its rostrum. The *Acacia* has not been positively identified but was probably *A. retinodes* Schlechtendal.

On 3 February 1983 a female *Adrisa erichsoni* Signoret was captured in Melbourne and confined with soil and seeds of *Acacia saligna* (Labill.) H. Wendl. During the following days the insect was observed feeding on and carrying the seeds and several seeds were found with the endosperm eaten out. The female produced at least six gregarious nymphs with bright orange-

red and black barred abdomens which sheltered beneath her body. The nymphs were first seen on 1 March. By 4 March the adult was dead along with two nymphs. Three of the progeny survived until 9 March but despite a definite increase in their size all were dead by 20 March.

Amongst the Hemiptera the habit of seed feeding is best developed in the Lygaeidae. The majority probably feed on ripe seed dropped to the ground (Woodward *et al.*, 1970). In the Cydnidae the only record of mature seed feeding appears to be that of McDonald (1968) who observed *Sehirus cinctus albonatus* Dallas feeding on *Stachys palustris* L. Woodward (1949) observed nymphs and adults of *Sehirus bicolor* (L.), a British species, feeding on young seed heads of *Ballota nigra* L. and Southwood (Southwood and Hine, 1950) saw the same species stem feeding from *Lamium album* L. These host plants belong to the Labiatae (Lamiaceae). My observations detailed above for *Adrisa* appear to be the first record of seed feeding on plants of the Mimosaceae (Woodward, 1983, pers. comm.).

The 18-24 day incubation period for *S. bicolor* eggs found by Southwood and Hine agrees with the outside limit established with the Melbourne female of *A. erichsoni*: if she deposited her egg mass soon after capture then a maximum period of 27 days elapsed before hatching. Female *Sehirus* seem to live for about one month after oviposition (Southwood and Hine, 1950), so the maximum 30 days recorded here for the single *Adrisa* female corresponds with the English record. Parental care is shown by several groups of the Pentatomoidea and nymphs of many species are gregarious in the first instar (Woodward *et al.*, 1970). Female Cydnidae protect their egg masses and newly hatched nymphs remain with the female for some 48 hours (Southwood and Hine, 1950). The observation of gregariousness in the nymphs of *Adrisa* and their protection by the female do not conflict with these generalities.

Acknowledgements

I am grateful to the late Dr T. E. Woodward who provided reference material and criticised the manuscript, Dr R. C. Froeschner for identifying the cydnids and the Herbarium of Victoria for attempting to identify the Yanakie *Acacia* from inadequate material.

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THE BUTTERFLIES OF MURRAY ISLAND, TORRES STRAIT, QUEENSLAND

By G. A. Wood
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Abstract

Butterfly species collected on Murray Island are listed and comments made on the variability and status of some of these. *Euploea batesii belia* Waterhouse & Lyell is shown to be a junior synonym of *E. b. resarta* Butler and *Taenaris artemis zetes* Brooks a junior synonym of *T. a. jamesi* Butler. It is also suggested that *Euploea core* on Murray forms part of a clinal variation through the Torres Strait Islands and that *E. algea amycus* appears to form part of this cline. *Hypolimnas antilope* (Cramer) is recorded within Australian limits for the first time; *Jamides amarauge* Druce is recorded from Murray Island for the first time.

Introduction

Murray Island is an extinct volcano in far eastern Torres Strait, lying 9°55′S and 144°03′E, which is approximately 135 km southeast of the Papua New Guinea coast and 195 km from the tip of Cape York Peninsula.

Approximately half of the island is covered with grass. Most of the remaining half is overgrown native gardens containing many exotic plants. Little of the original vegetation remains in an undisturbed state, land clearing and annual burning being responsible for this situation.

Lying 45 km north-east of Murray Island, and in a direct line with the closest point of the Papua New Guinea coast, is Darnley Island. Because of the isolation of Murray Island little collecting has been undertaken and material is poorly represented in collections. Two collecting trips were made by the writer, one in 1984 between 20 April and 4 May and the other during the same period in 1985.

A total of fifty species were taken. Five specimens of *Hypolimnas antilope* (Cramer) represent the first taken within Australian limits. *Jamides amarauge* Druce is recorded from Murray Island for the first time. Eight species recorded from Darnley Island have not been taken on Murray Island. Most of these are probably vagrants from the Papua New Guinea mainland which have not reached as far as Murray Island.

Examination of the material collected has called into question the validity of some races and of one species previously recognised for the island.

Euploea batesii resarta Butler, 1876

Euploea batesii belia Waterhouse & Lyell, 1914; *Butterflies of Australia*: 22. N. syn.

The race *belia* was erected on eight specimens. *Euploea batesii* is a common and variable species on Murray Island and there is no justification for the race *belia.* The 50 specimens taken show the continuous variation found in *resarta* (Fig. 1). *Euploea batesii resarta* is found throughout New Guinea and the Louisade and D'Entrecasteaux archipelagos. D'Abrera (1977) states that it is "A very variable race".

Euploea core corinna (W. S. Macleay, 1826)

Euploea core on Murray Is. appears to represent part of a clinal variation and the variability between specimens seems sufficient to encompass specimens designated *Euploea algea amycus* Miskin. A large series taken on Murray Is. show specimens resembling *core* and *algea* but the great majority display intermediate characters (Fig. 2).

With respect to *core* Ackery and Vane-Wright (1984) state they can offer no autapomorphies to define this well known butterfly. They describe *algea* as a polytypic cladospecies–based on a single doubtful autapomorphy. Their key separates the two on the male sex brand being larger in *algea* than in *core*, with the additional problem that some specimens are not clearly one or the other. This is certainly the case on Murray Is., where the extent of the white spotting is equally variable.

Taenaris artemis jamesi Butler, 1876

Taenaris artemis zetes Brooks, 1944, *Proc. R. ent. Soc. Lond.* (B)13: 114. N. syn.

Three specimens of this species taken on Murray Island cannot be separated from specimens taken on Darnley Island. All three lack the larger ocelli and the additional small ocellus at the costa upon which the race *zetes* is based.

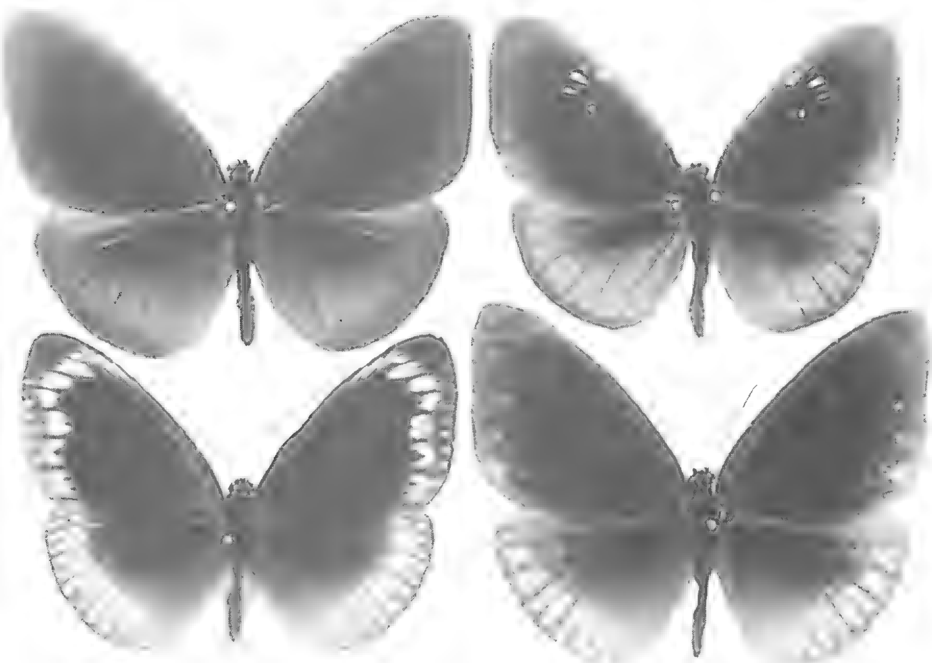

Fig. 1. Variation in *Euploea batesii resarta* from Murray Island.

Fig. 2. Variation in *Euploea core corinna* from Murray Island: the top four specimens are males; the 4 bottom specimens females.

List of species collected on Murray Island

HESPERIIDAE
Hasora chromus chromus (Cramer)
Badamia exclamationis (Fabricius)
Notocrypta waigensis proserpina (Butler)
Ocybadistes ardea heterobathra (Lower)
Suniasa sunias rectivatta (Mabille)
Telicota augias krefftii (W. S. Macleay)
Cephrenes trichopepla (Lower)
Borbo cinnara (Wallace)
Pelopidas agna dingo Evans
Pelopidas lyelli lyelli (Rothschild)

PAPILIONIDAE
Graphium macfarlanei macfarlanei (Butler)
Graphium eurypylus (Linnaeus)
Papilio aegeus ormenus Guérin-Méneville
Papilio fuscus indicatus Butler
Papilio ambrax ambrax Boisduval
Cressida cressida cressida (Fabricius)
Atrophaneura polydorus queenslandicus (Rothschild)

PIERIDAE
Catopsila pomona pomona (Fabricius)
Eurema hecabe phoebus (Butler)
Cepora perimale latilimbata (Butler)

NYMPHALIDAE
Danaus hamatus hamatus (W. S. Macleay)
Euploea core corinna (W. S. Macleay)
Euploea tulliolus tulliolus (Fabricius)
Euploea batesii resarta Butler
Melanitis leda bankia (Fabricius)
Mycalesis sirius sirius (Fabricius)
Mycalesis terminus terminus (Fabricius)
Mycalesis perseus perseus (Fabricius)
Orsotriaena medus moira Waterh. & Lyell
Xois arctoa arctoa (Fabricius)
Taenaris artemis jamesi Butler
Doleschalia bisaltide australis Felder
Hypolimnas bolina nerina (Fabricius)
Hypolimnas misippus (Linnaeus)
Hypolimnas alimena lamina Fruhstorfer
Hypolimnas antilope (Cramer)[1]
Yoma sabina parva (Butler)
Junonia orithya albicincta Butler

LYCAENIDAE
Athene seltuttus affinus (Waterh. & Lyell)
Catopyrops ancyra mysia (Waterh. & Lyell)
Danis cyanea arinia (Oberthur)
Jamides phaseli (Mathew)[2]
Jamides amarauge Druce[3]
Jamidea sp.[4]
Catochrysops panormus platissa (Herrich-Schäffer)
Lampides boeticus (Linnaeus)
Zizeeria karsandra (Moore)
Zizina labradus labradon Waterh. & Lyell
Famegana alsulus alsulus (Herrich-Schäffer)
Euchrysops cnejus cnidus Waterh. & Lyell

1. Previously unrecorded from within Australian limits.
2. A large series taken agree with the comment of Johnson (1983) concerning Darnley Island specimens. They differ from mainland specimens in brightness and width of the dark margins on the wings, but some resembling mainland specimens were taken with specimens ranging to pale blue.
3. Previously unrecorded from Murray Is.
4. These are the same as a pair of *Jamides* sp. taken on Darnley by Johnson (1983).

Acknowledgements

I wish to thank G. B. Monteith, Queensland Museum, and E. D. Edwards, C.S.I.R.O., Canberra, for help with identification of specimens and access to literature. Thanks are extended to M. S. Moulds for help with the manuscript.

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THE LIFE HISTORY OF *NEPTIS PRASLINI STRAUDINGEREANA* DE NICEVILLE (LEPIDOPTERA: NYMPHALIDAE: NYMPHALINAE)

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Abstract

The life history of *Neptis praslini straudingereana* de Niceville is described and a food plant listed.

Introduction

The black and white aeroplane, *Neptis praslini straudingereana*, is distributed from Cape York to Tully (Common and Waterhouse, 1981). While bushwalking at Iron Range I observed a female of this species to oviposit on the foliage of a climbing plant. Eggs were collected and the resultant larvae were raised on cuttings of the foodplant.

Life history

Foodplant. Phylacium bracteosum Benn. Fabaceae.

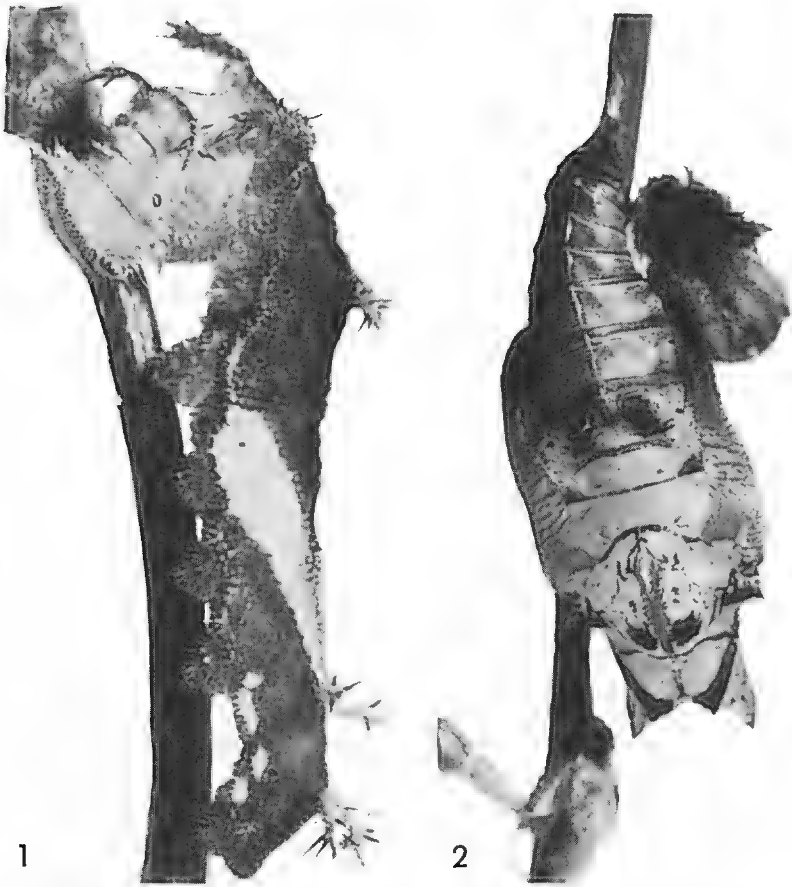
Egg. 1 mm high. Green, deeply pitted, densely covered with short hairs, spherical (slightly higher than wide).

First instar. Length 4 mm. Head pale brown, round,, roughly textured. Body pale green, roughly textured, with a raised band of tubercles between segments.

Third instar. Length 10 mm. Head elongate, pitted, with short spines, short hairs, and with pointed vertical, dorso-lateral horns. White, with black central line which forks and outlines the frons. Also with branching black lines from horns to base of head. Body covered with small tubercles; meso- and metathorax with a pair of forward curving, outward directed, spiny dorso-lateral processes, those on metathorax longest. Abdomen with a pair of spiny, dorso-lateral processes, on segments two, eight and nine; processes on segments two and nine directed backwards, those on eight outwards. White with large, down-curving, green 'saddle' between metathoracic processes and processes on ninth abdominal segment; within green 'saddle' a small black area encompassing the processes on the second abdominal segment.

Fifth instar (Fig. 1). Length 23 mm. Head as in third instar but with spines more obvious, colour greenish-white. Body as in third instar but pale green, darkening toward the rear where a broken white basal line is located. Processes on mesothorax and abdominal segments eight and nine white with black spines, those of large green 'saddle' replaced with white which commences at the base of the fourth segment and curves up along the body to terminate with the processes on the ninth abdominal segment. Pairs of processes on meso- and metathorax joined by white and dark green transverse lines. Spiracles black, edged white.

Pupa (Fig. 2). Length 16 mm. Anterior end with two lateral projections, thorax with strong dorsal ridge; abdomen with dorsal ridge and dorso-lateral



Figs 1, 2. *Neptis praslini straudingereana*: (1) fifth instar larva on food plant; (2) pupa.

projections on second segment. Head and thorax silver-cream with black striae. Abdomen silver-cream with scant suffusions of black. Suspended by cremaster.

Notes. Eggs are laid singly beneath the leaves of the foodplant. Larvae shelter beneath the leaves and feed day or night. Pupation occurs on the foodplant.

A life cycle, completed in thirty six days, commenced in early December. The egg hatched in six days, the larval stage took twenty one days, and the pupal duration was nine days.

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Common, I. F. B. and Waterhouse, D. F., 1981. *Butterflies of Australia.* Revised edition. Angus and Robertson, Sydney. 682 pp.

NOTES ON THE BIOLOGY OF *CANDALIDES CYPROTUS CYPROTUS* (LEPIDOPTERA: LYCAENIDAE)

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Abstract

The early stages of *Candalides cyprotus cyprotus* (Olliff) are described and figured. Observations of its behaviour are discussed.

The unusual behaviour of the first instar larvae "ring-barking" the flowers of *Conospermum* spp. is described. A suggestion is made that the larvae may be obtaining some substance from the flower pedicels. In this process the flowers are destroyed and more lateral leaves may be produced on the plants which could provide more food for the next generation of larvae.

C. cyprotus cyprotus appears to be strongly associated with *Conospermum* spp. in the coastal heaths and sandy woodlands in the Sydney, Gosford and Hunter regions. This association with *Conospermum* spp. rather than *Jacksonia scoparia* may indicate that they are not conspecific with other populations e.g. *Candalides cyprotus pallescens* (Tite) and even any other populations feeding on *Grevillea* spp.

Introduction

Candalides cyprotus (Olliff), is distributed locally in southern Australia from central Queensland to Western Australia (Common and Waterhouse 1981). One described subspecies, *C. cyprotus pallescens*, is restricted to Queensland and northern New South Wales. The life history of *C. cyprotus* is not fully known but the food plants recorded are *Jacksonia scoparia* R. Br. in Queensland and New South Wales, *Grevillea* sp. at Braidwood, N.S.W. and *Grevillea bracteosa* near Geraldton, W.A. (Common and Waterhouse 1981, Atkins 1984).

Candalides cyprotus cyprotus (Olliff)

The following observations were recorded from populations of *C. cyprotus cyprotus* occurring in coastal dune-heath at Port Stephens, central coast N.S.W.

Foodplant.–*Conospermum taxifolium* Sm. (Proteaceae).

Egg. (Fig. 1).–0.6 mm diameter; pale green, with reticulated pattern of six-sided pits and blunt projections (Fig. 5). Egg hatches in nine days.

Larva.–First instar: length 1 mm; pale yellow-green, covered with numerous long setae. Second to final instar (Fig. 2): length 2 mm to 15 mm; pale green to purplish-green with lateral row of emerald green spots; first three (thoracic) segments with paired dorsal tubercles coloured turquoise at tips; abdominal segments with similar single dorsal tubercles; anal segment with single dark-green dorso-lateral tubercle and single long, blue, distally placed lateral tubercle; body covered with short, dark-brown setae. head, brown, retractable under first segment. Larval duration approximately 8 weeks.

Pupa (Fig. 4).–Length 12 mm; dull black, heavily textured; slightly serrated, paired projections on frons and dorsal portion of thorax. A dorsal projection

of each of the last seven abdominal segments tapered posteriorly and flanged laterally.

Notes.—Adults of *C. cyprotus cyprotus* were observed from August to January but apparently were single-brooded in central N.S.W., the pupal duration being at least nine months. In the Hunter region the butterfly appeared to be absent from woodland areas where *J. scoparia* was abundant.

Males "hilltopped" on sand-dunes in warm sunny weather but females were less frequently seen, preferring to remain at rest in the shelter of vegetation, near groups of *Conospermum* spp. or on the ground in sandy clearings. When active, the female flew strongly a metre or two above the ground, briefly visiting flowers, particularly species of the family Proteaceae.

The eggs were laid singly on the pedicel or peduncle of an inflorescence of *C. taxifolium.* The freshly hatched larvae crawled to a flower and ate portions of the inner surface of the calyx-tube. Later the larvae moved down the plant to eat the leaves. Near the completion of the first instar the larvae returned to the flowers and proceeded to "ring-bark" each pedicel methodically, causing each flower to wither and drop to the ground. Second to final instar larvae fed on the leaves of the plant, stripping all but the mid-rib. They fed mainly in the morning and evening and remained unconcealed on the plant when at rest.

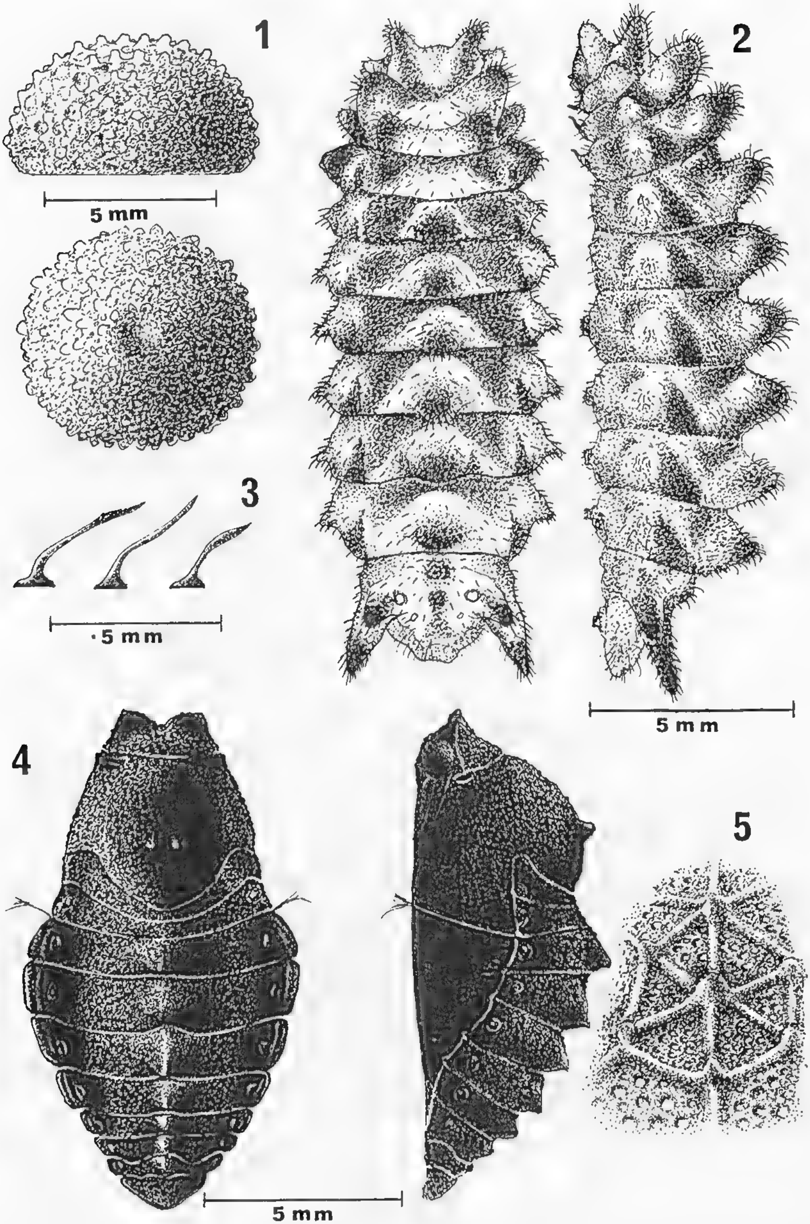
The pupation sites were not recorded in the field, but the dark colour of the pupa and the long pupal duration suggested that concealment was necessary and pupation may occur in debris or leaf litter.

Discussion

The peculiar eating habits of the first instar larva is one worthy of attention. A suggestion is put forward here in an attempt to explain the behaviour. The first instar larvae of this butterfly may require some substance which is only present in the flower pedicels and this may compel them to "ring-bark" the pedicels. Further studies would be required to check this.

The plant may respond by increasing leafy growth. The possible increase in leafy growth may be explained thus; auxin, a plant hormone, is produced in the shoot-tips of plants and is also probably abundant in embryos, young leaves, flowers and fruits. Auxin has been shown (Raven *et al.* 1982), amongst other roles, to have an inhibitory effect in relation to the growth of lateral buds. If the terminal shoot-tip with the apical meristem were removed, the auxin influence ceases, stimulating outgrowth of dormant lateral buds. The plant would renew the shoot system instead of building woody tissues (Harper 1978).

The inflorescence of *C. taxifolium*, a corymbose panicle, is formed at the uppermost leaf-axils. This type of inflorescence is a raceme type which continues to grow in length more or less indefinitely i.e. the apical meristem persists (Rost *et al.* 1979). If the first instar larva of *C. cyprotus cyprotus* "ring-bark" and kill the flowers and terminal shoot, then the influence of auxin would be removed and the lateral shoots would then develop. The possible increased leaf surface area over the whole plant would be beneficial



Figs 1-5. Life history of *Candalides cyprotus cyprotus* (Olliff): (1) egg, lateral and dorsal view; (2) 5th instar larva, lateral and dorsal view; (3) larval setae; (4) pupa, lateral and dorsal view; (5) detail of egg reticulation.

to the larvae of the next generation of the butterfly. This would also require further field studies to determine if this occurs in this case.

C. cyprotus cyprotus appears to be strongly associated with *Conospermum* spp. in the heaths and sandy woodlands of the Sydney, Gosford and Hunter regions. In these areas the butterfly appears to be absent from woodlands containing *Jacksonia scoparia.* This suggests that *C. cyprotus cyprotus* and *C. cyprotus pallescens* and even other populations feeding on *Grevillea* spp. may not be conspecific. Further investigations into the feeding preference, behaviour of the juvenile stages and taxonomic studies of the adults are required to settle this question.

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NOTES ON THE DISTRIBUTION OF TWO SKIPPERS (LEPIDOPTERA: HESPERIIDAE) FROM NEW SOUTH WALES

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Abstract

A new locality for *Toxidia andersoni* (Kirby) and *Signeta tymbophora* (Meyrick and Lower) is recorded.

In New South Wales *Toxidia andersoni* is recorded as fairly common in the New England National Park and as rare at several other localities (Common and Waterhouse, 1981). It is also recorded from Mount Allyn, N.S.W. (Wilson, 1984). *Signeta tymbophora* is known from Mount Warning and from Gosford to Mount Dromedary (Common and Waterhouse, 1981).

On 26 and 27 January, 1986 I collected a female *Toxidia andersoni* and four male specimens of *Signeta tymbophora* on North Brother Mountain, near Laurieton, N.S.W. Both species occurred around the edges of a patch of rainforest near the summit of the mountain.

These records represent the most northern known coastal locality for both species.

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MEALYBUGS (COCCOIDEA: PSEUDOCOCCIDAE) FROM THE AUSTRALIAN NATIONAL BOTANIC GARDENS, CANBERRA

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Abstract

This paper reports on 14 species of mealybugs from eight genera collected from the Australian National Botanic Gardens, Canberra, between January 1981 and March 1984. The appearance in life and habit of the adult female, host-plant associations and plant damage are recorded for each mealybug species.

Introduction

The Australian National Botanic Gardens (ANBG) located on Black Mountain, Canberra, ACT, contain the largest living collection of Australian native plants. Control of coccoids (Coccoidea: scale insects and mealybugs) is a significant horticultural task for the gardening staff. Coccoids are some of the most common nuisance insects in the ANBG and are controlled by utilizing an intergrated method involving predators, parasitoids, pruning, hand removal, or spraying, drenching and injection of the systemic insecticide dimethoate (Rogor 40®).

In 1981, S. R. Donaldson began assembling a reference collection of the coccoids of the ANBG to aid the identification of horticultural pests. Identification and further collection were carried out in collaboration with P. J. Gullan from 1982 to the present. G. A. Knox collected and catalogued specimens and prepared many of the slide-mounts that are essential for species identification. The preserving and slide-mounting techniques of Gullan (1984) were used for all microscopic preparations. Slide-mounted females and dry specimens *in situ* have been deposited in the Australian National Insect Collection, CSIRO, Canberra.

The recent taxonomic revision of Australian mealybugs (family Pseudococcidae) by Williams (1985) greatly facilitated identification of the mealybug species. Williams (1985) also reviews biological information on mealybugs of economic importance. Many of the mealybugs reported in this paper can cause considerable damage to native plants if not controlled.

This paper records the appearance in life and habit of the adult female, host-plant data and plant damage for each of the 14 mealybug species collected in the ANBG between January 1981 and March 1984. Information on natural enemies is included. The botanical nomenclature is that of Beadle, Evans and Carolin (1972) and Willis (1972). The host-plant data augment those available in Williams (1985). Williams (1985) could not examine live females of most Australian mealybug species and therefore the descriptions in this paper supplement his descriptions of slide-mounted females.

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Records

Australicoccus grevilleae (Fuller)

Appearance.–Body of adult ♀ ovoid to sub-globose, dark purple, with a dense white cottony wax covering 0.3-0.5 mm thick; wax-covered ♀ globose, 2-5 mm in diameter.
Habit.–Stationary on stems and in leaf axils, often densely aggregated.
Host plants.–Many *Grevillea* spp., especially *G. arenaria* R.Br., *G. miqueliana* F. Muell. and *G. mucronulata* R.Br. This mealybug has been recorded from many *Grevillea* spp. in NSW, ACT, Vic, SA, WA, and NT (Williams 1985).
Plant damage and natural enemies.–Lack of vigour, reduced flowering, reduced leaf size and leaf number, associated with minor sooty mould; caused damage all year. In the ANBG, neuropteran and coccinellid larvae and two species of hymenopteran parasitoid have been collected or reared from infestations. This mealybug has caused major damage to suburban plantings of *G. rosmarinifolia* A. Cunn. and *G. victoriae* F. Muell., which are frequently used as hedges and screens within the ACT.

Australicoccus hibbertiae (Maskell)

Appearance.–Body of adult ♀ sub-globose, reddish to purple black, with a white granular wax covering 0.1-0.5 mm thick, forming discrete tufts on dorsum of mature specimens and a wax cushion below; wax-covered ♀ globose, 1.5-3.0 mm in diameter.
Habit.–On stems, leaf bases and bases of flowers or fruits, usually occurring singly.
Host plants.–*Hibbertia calycina* (DC.) N.A. Wakefield and *H. stricta* (DC.) R.Br. ex F. Muell. *A. hibbertiae* appears to be confined to *Hibbertia* and has been collected in NSW, Vic and SA (Williams 1985).
Plant damage.–Minor lack of vigour in *H. calycina*, but this plant occurs naturally in the ANBG. Minor defoliation of *H. stricta.*

Dysmicoccus anicus Williams

Appearance.–Body of adult ♀ oval, flattish, 2.0-3.2 mm long, grey, segments distinct, covered with white powdery wax, bearing robust lateral wax filaments 0.1-0.3 mm long and 4 (2 pairs) robust caudal filaments 0.5-1.7 mm long and about 0.2 mm thick.
Habit.–In crevices of distorted growth or 'witches broom' caused by a rust belonging to *Uromycladium.*
Host plants.–*Acacia implexa* Benth. and *A. melanoxylon* R.Br. This species has been recorded from *Acacia* spp. in Qld, ACT and SA and from the bark of *Eucalyptus camaldulensis* Dehnh. in SA (Williams 1985).
Plant damage.–Unknown, usually associated with damage caused by other agents.

Dysmicoccus banksi Williams

Appearance.–Body of adult ♀ elongate oval, flattish, 2-3 mm long, grey, segments distinct, covered with white powdery wax forming indistinct dorsal longitudinal stripes and bearing slender lateral wax filaments 0.1-0.2 mm long and 4 (2 pairs) slender caudal filaments up to 2 mm long but less than 0.1 mm thick.
Habit.–On stems, in large numbers in warm weather.
Host plant.–*Acacia verticillata* (L 'Hérit.) Willd. This mealybug has been collected from NSW, ACT and Vic only on *Acacia* spp. (Williams 1985). It has not previously been recorded on *A. verticillata.*
Plant damage.–Minor lack of vigour and minor sooty mould.

Erium globosum (Maskell)

Appearance.–Body of adult ♀ sub-globose, pinkish tan, covered by a thick white waxy secretion about 1 mm deep; wax-covered ♀ globose, 3-6 mm in diameter.
Habit.–On stems, often densely aggregated.
Host plants.–*Acacia howittii* F. Muell., *A. mucronata* Willd. ex Wendl. and *A. oxycedrus* Sieber ex DC. The present data and those of Williams (1985) show that *E. globosum*

has been recorded from seven species of phyllodinous wattle in ACT, Vic, SA and WA. There are no records from bipinnate wattles.
Plant damage and natural enemies.–Major lack of vigour, reduced flowering and caused defoliation on mature foliage. The larvae of *Cryptolaemus montrouzieri* Mulsant (Coccinellidae) controlled this mealybug in the ANBG during warmer months.

Maconellicoccus australiensis (Green and Lidgett)

Appearance.–Body of adult ♀ ovoid, 1.5-3.5 mm long, light grey brown, lightly covered with white powdery wax, body segments distinct due to aggregation of wax in deep intersegmental grooves in three dorsal longitudinal bands, producing a striped appearance.
Habit.–On stems, foliage and young seed pods, often heavily infesting branches.
Host plants.–*Acacia drummondii* Lindl. spp. *elegans* and *A. melanoxylon* R.Br. This mealybug has been recorded from many *Acacia* spp., both bipinnate and phyllodinous, in Qld, NSW, ACT, Vic and SA (Williams 1985).
Plant damage.–Frequently caused shoot distortion and dieback. Brookes (1971) discusses damage caused by this mealybug.

Melanococcus senticosus Williams

Appearance.–Body of adult ♀ oval, dorsally convex with abdomen slightly concave ventrally at maturity, 2.0-3.5 mm long, dorsum green, venter black, segmentation distinct, powdery wax sparse and almost absent dorsally, confined to margins of body and abdomen ventrally. No ovisac produced. Immature ♀ grey.
Habit.–On rhachides and pinnae of bipinnate leaves; infestation normally heavy.
Host plant.–*Acacia dealbata* Link. The only other record of this mealybug is from the phyllodinous wattle *A. podalyriifolia* Cunn. ex G. Don in Qld (Williams 1985).
Plant damage and natural enemies.–Little effect on vigour and no shoot distortion despite high density. In the ANBG, the coccinellid predators *Cryptolaemus montrouzieri* and *Parapriasus australasiae* (Boisduval) have been associated with an infestation and meat ants, *Iridomyrmex purpureus* (F. Smith), have been observed attending mealybugs to obtain honeydew.

Nipaecoccus ericicola (Maskell)

Appearance.–Body of adult ♀ oval, dorsally convex, becoming ovoid to sub-globose at maturity, 1.5-2.8 mm long, claret to purple-black coloured, with white sparse powdery wax dorsally and squat lateral wax filaments, 0.1-0.2 mm long, on abdominal segments, longest on anal lobes. Ovisac produced ventrally, composed of white glassy wax filaments.
Habit.–Mostly in axils of leaves and flowers or at shoot apices; very mobile.
Host plants.–*Hibbertia obtusifolia* DC., *Persoonia pinifolia* R.Br., *P. linearis* (Andr.) x *P. pinifolia*, *Phebalium stenophyllum* (Benth.) Maiden and Betche, *Prostanthera lasianthos* Labill. and *Westringia longifolia* R.Br. This common and widespread species has been recorded from Qld, NSW, ACT, Vic, SA and Tas on host-plant species belonging to 10 families (Williams 1985). Collection of this mealybug on *Phebalium* in the ANBG adds an eleventh host-plant family (Rutaceae) to this list.
Plant damage. Shoot distortion and fruit abortion.

Nipaecoccus exocarpi Williams

Appearance.–Body of adult ♀ ovoid, purplish, covered in white wax with distinct tufts laterally and irregular aggregations dorsally, cuticle barely visible. Ovisac pale yellow, produced ventrally, most conspicuous posteroventrally, composed of glassy wax filaments; ♀ plus ovisac 2-3 mm long.
Habit.–Along branchlets, usually near tips.
Host plant.–*Exocarpos cupressiformis* Labill. This mealybug has been recorded only from *Exocarpos* spp. in the ACT and Vic (Williams 1985).
Plant damage and natural enemies.–Lack of vigour and sectional death of branchlets.

In the ANBG a coccinellid predator, *C. montrouzieri*, and a dipteran parasitoid, *Meliscaeva* sp., are natural control agents.

Planococcus citri (Risso)

Appearance.–Body of adult ♀ oval, flattish, 1.5-3.0 mm long, yellow, covered in white powdery wax, with lateral wax filaments 0.1-0.5 mm long and up to 0.1 mm thick; pair of caudal filaments not appreciably longer than others, but robust and up to 0.8mm long. Ovisac produced posteroventrally, composed of white glassy filaments. This species can easily be confused with *Planococcos pacificus* Cox (Cox 1981) which has not been collected in the ACT.
Habit.–On all plant parts. Mostly confined to glasshouses in the ANBG.
Host plants.–Very wide range in the ANBG. This cosmopolitan species is polyphagous (see Williams 1985).
Plant damage.–Severe if unchecked.

Pseudococcus chenopodii Williams

Appearance.–Body of immature adult ♀ oval, grey with sparse covering of powdery wax and lateral and caudal wax filaments.
Habit.–On stems near flower buds.
Host plant.–*Phebalium stenophyllum* (Benth.) Maiden and Betche, but probably an accidental occurrence. Williams (1985) records this species from NSW and SA apparently feeding exclusively on members of the plant family Chenopodiaceae. Only one collection of two adult specimens of *P. chenopodii* has been made in the ANBG, however these were found on a member of the Rutaceae. Plants of *Chenopodium album* L. grow in the vicinity of the collection site and the mealybugs may have been wandering on a non-host plant.
Plant damage.–None apparent.

Pseudococcus hypergaeus Williams

Appearance.–Unknown since the 2 specimens collected were preserved without record of their appearance in life.
Habit.–On young stems.
Host plant.–*Persoonia pinifolia* R.Br. Williams (1985) records *P. hypergaeus* from Qld, NSW, Vic, SA, Tas, and NZ on 12 host-plant genera, including *Persoonia*, in 7 families and notes that there is some variation amongst specimens presently assigned to this species.
Plant damage.–None apparent.

Pseudococcus longispinus (Targioni Tozzetti)

Appearance.–Body of adult ♀ oval, flattish, 2.0-3.5 mm long, pale yellow to ochre, covered in white powdery wax, with lateral wax filaments 0.2-1.0 mm long, length increasing posteriorly, and up to 0.1 mm thick; 2 pairs of long caudal filaments 0.1 mm thick with anal lobe pair up to 3 mm long.
Habit.–On all plant parts, usually in large numbers. Mostly confined to glasshouses in the ANBG.
Host plants.–Very wide range in the ANBG. *P. longispinus* has been recorded from numerous host plants in Qld, NSW, ACT, Vic, SA, Tas and WA and "is probably one of the commonest Australian mealybugs, found on numerous host plants in greenhouses and in the open, especially on pears, grape-vines and *Citrus*" (Williams 1958, p. 317).
Plant damage.–Extensive if unchecked. See Williams (1985) for discussion of the economic importance of this mealybug in Australia.

Pseudococcus sp.

This undescribed species will be formally named and described elsewhere.
Appearance.–Body of adult ♀ elongate oval, flattish 2.0-2.8 mm long, pale yellow to

pale salmon colour when mature, sparsely covered in white powdery wax, with lateral wax filaments 0.1-0.7 mm long, decreasing in length from posterior to anterior of body and 4 (2 pairs) robust caudal filaments up to 1.6 mm long and 1.0-1.5 mm thick, with anal lobe pair thickest. Immature ♀ greyish.

Habit.–In folds of leaves prior to leaf opening, predominantly at leaf bases.

Host plant.–*Xanthorrhoea australis* R. Br. ssp. *australis* (family Xanthorrhoeaceae). This is the first record of a mealybug on *Xanthorrhoea.*

Plant damage.–Chlorosis and mild pitting sometimes occurred.

Acknowledgements

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BOOK REVIEW

Plant virus epidemics: monitoring, modelling and predicting outbreaks. Editors G. D. McLean, R. G. Garrett and W. G. Ruesink. 1986. Academic Press Australia, 30-32 Sidmore St, Marrickville, N.S.W. 2204. ISBN 0 12 485060 X. xxi, 550 pages, illustr.

It is indeed pleasing to see this book; as the Forward states "There has been no previous book devoted to this largely neglected topic . . . The extent of the work done and the progress made will come as a revelation to many readers as much of the information had previously appeared in a fragmented or inaccessible form".

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C. HOLMES

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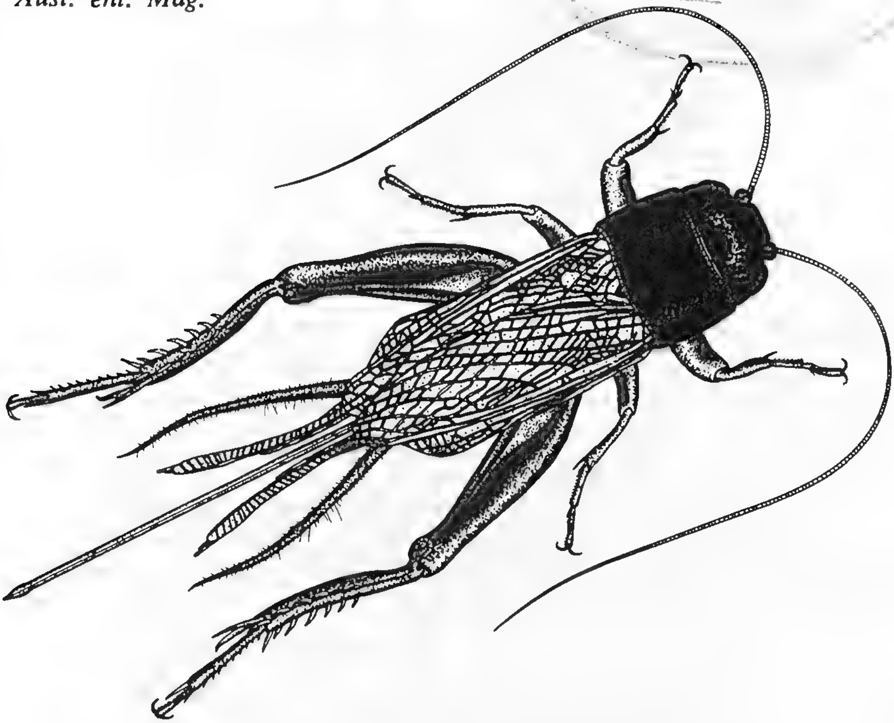

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COVER

Illustrated by Alan Westcott.

Black field cricket, *Teleogryllus commodus* (Walker). This native Australian insect is sometimes a serious pest of pastures and crops in Victoria, New South Wales and New Zealand. Damage is caused by adults and late stage nymphs chewing on leaves and stems of young plants at night. Plagues originate in grasslands and pastures, the crickets swarming at dusk during warm, calm weather.

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THE BUTTERFLIES (LEPIDOPTERA) OF CHRISTMAS ISLAND, INDIAN OCEAN

By M. S. MOULDS and R. B. LACHLAN

Research Associate, Australian Museum, 6-8 College St, Sydney, N.S.W. 2000
and
34 Roscommon Cres., Killarney Hts, Sydney, N.S.W. 2087

Abstract

Twenty two butterfly species are now known to occur on Christmas Island. This paper lists seven species previously unrecorded, viz. *Papilio demoleus malayanus* Wallace, *Eurema blanda* (Boisduval), *Nacaduba kurava* (Moore), *Jamides bochus* (Stoll), *Catochrysops panormus* (Felder), *Lampides boeticus* (L.) and *Zizina otis* (F.). In addition a second form of *Catopsilia pomona* (F.) is recorded for the first time. Only two species *Eurema amplexa* (Butler) stat. rev. and *Polyura andrewsi* (Butler) are endemic. The male genitalia of *Eurema amplexa* shows that it should not be considered a subspecies of *E. hecabe* (L.) but deserves specific status.

Introduction

Christmas Island, Indian Ocean, lies some 360 km south of the Indonesian island of Java and about 1400 km from Western Australia. The island is isolated from other landmasses and has an area of approximately 137 sq km. It has a planar surface with a maximum elevation of 357 m and is terraced right around the island.

Rainforest covers much of the island's surface but the number of plant species is lower than one would expect. Two vegetation types can be recognised. A simple mesophyll forest on the plateau and a more complex and diverse flora around the limestone terraces. Ridley (1906) points out that numerous exotic and weed species have been introduced, particularly around areas of human habitation.

The first butterflies to be recorded from Christmas Island were two species described by Butler (1887). The following year he listed an additional

three species (Butler 1888) and later (Butler 1900) he increased the number of recorded species to nine. Pendlebury (1933) brought the number of known species to 11, Corbet (1938) added another and Gibson-Hill (1947) increased the total further to 14 but failed to include the one species mentioned by Corbet (1938). In this paper we record a total of 22 species.

In 1985 one of us (RBL) visited Christmas Island and collected butterflies intensively from 9-31 January. 255 specimens of 13 species were taken which are now housed in the collections of RBL, Australian National Insect Collection, Canberra (ANIC) and British Museum (Natural History) London (BMNH). Other specimens of Christmas Island butterflies previously unstudied are housed in the collections of (ANIC) and Western Australian Museum, Perth (WAM). From all this material and the published literature we summarize below the butterflies now known from Christmas Island including seven previously unrecorded species, *Papilio demoleus malayanus* Wallace, *Eurema blanda* (Boisduval), *Nacaduba kurava* (Moore), *Jamides bochus* (Stoll), *Catochrysops panormus* (Felder), *Lampides boeticus* (L.) and *Zizina otis* (F.), and a second form of *Catopsilia pomona* (F.). One taxon, *Eurema hecabe amplexa* (Butler), has been returned to specific status.

List of species

FAMILY PAPILIONIDAE

Papilio demoleus malayanus Wallace

Material examined.—1 ♂, Flying Fish Cove, 5.vii.1961, G. F. Mees, WAM Reg. No. 85/1132 (WAM). 2 ♂♂, Flying Fish Cove, 31.vii.1975, Settlement Area, 10.viii.1975, A. N. Gillison; 1 ♀, Flying Fish Cove, 30.vii.1975, B. Bell (ANIC).

Previously unrecorded from Christmas Island.

FAMILY PIERIDAE

Catopsilia pomona pomona (F.)

form *pomona*

Catopsilia crocale crocale Cramer: Gibson-Hill, 1947: 80.

Material examined.—7 ♂♂, 4 ♀♀, Christmas Is., 16, 21, 23, 24.i.1985, R. B. Lachlan (RBL). 1 ♂, Flying Fish Cove, 8.vii.1961, G. F. Mees, WAM Reg. No. 85/1133 (WAM). 4 ♂♂, Settlement, 2, 12, 20.x.1964, T. G. Campbell; 1 ♂ 1♀, Flying Fish Cove, 5.viii. 1975, A. N. Gillison (ANIC).

Taken in Jan., May, July, Aug., Oct.

form *crocale*

Material examined.—8 ♂♂, 11 ♀♀, Christmas Is., 12, 14, 16, 21, 23, 24.i.1985, R. B. Lachlan (RBL).

Form *crocale* has not previously been recorded from Christmas Island; the specimen referred to by Gibson-Hill (1947) was, in fact, form *pomona.*

It is interesting to note that this species was not taken on Christmas Island until May 1940 (Gibson-Hill, 1947). Ridley (1906) does not mention any *Cassia* or *Butea* species (the only known food plants of *C. pomona*) but *Cassia* is now a plentiful introduced species on the island.

Eurema blanda blanda (Boisduval)
(Figs 1, 3-6)

Material examined.—17 ♂♂, 1 ♀, Christmas Island, 12, 13, 15, 19, 21, 23, 24, 25.i.1985, R. B. Lachlan (RBL). 2 ♂♂, ½ mi S of Drumsite, 30.ix.1964, T. G. Campbell; 1 ♂, Flying Fish Cove, 5.viii.1975, A. N. Gillison (ANIC).

Previously unrecorded from Christmas Island. Differs from *E. amplexa* in having the fore wing black band above clearly much broader at wing apex and a fore wing length rarely below 21 mm. The degree of indentation in the fore wing black band is variable; most males we examined showed little indentation, but two taken by RBL are deeply indented. The male genitalia (Fig. 1) are characteristic for the species and in four males we examined, covering the range of border variation, the genitalia are constant.

Eurema amplexa (Butler) stat. rev.
(Figs 2, 7-10)

Terias amplexa Butler, 1887: 523, fig. 5; Butler, 1888: 544; Butler, 1900: 63; Ridley, 1891: 129, 131.

Terias patruelis Butler, 1888: 545 (not Moore); Ridley, 1891: 131.

Terias moorei amplexa (Butler): Fruhstorfer, 1909-1911, [1910]: 169.

Eurema hecabe amplexa (Butler): Corbet & Pendlebury, 1932: 158; Pendlebury 1933: 95; Gibson-Hill, 1947: 75; D'Abrera, 1982: 183.

Material examined.—13 ♂♂, 1 ♀, Christmas Is., 12, 13, 21, 24, 31.i.1985, R. B. Lachlan (RBL). 2 ♂♂, Field 22C area and Field 25 Dales, x.1983, L. Hill; 1 ♀, Settlement, 2.x.1964, T. G. Campbell; 1 ♂, Survey Point, Tom's Ridge, 13.x.1964, C. Coogle; 4 ♂♂, South Point, 8, 21.x.1964, T. G. Campbell; 1 ♂, Flying Fish Cove, viii.1975, A. N. Gillison (ANIC). 2 ♀♀, Blow Hole, 7.vii.1961, G. F. Mees (WAM Coll. Reg. Nos 85/1135, 36); 1 ♀, South Point, 4.vii.1961, G. F. Mees (WAM Coll. Reg. No. 85/1134) (WAM).

Differs from *E. blanda* by not having the fore wing black band above greatly expanded at wing apex. *E. amplexa* is also smaller than *E. blanda* with a fore wing length never exceeding 21 mm while that of *blanda* rarely falls below 21 mm. In addition the fore wing border in the male is always evenly scalloped but that of *blanda* is erratic.

Examination of the male genitalia (Fig. 2) has confirmed that this species is not a subspecies of *E. hecabe* as stated by Corbet & Pendlebury

1


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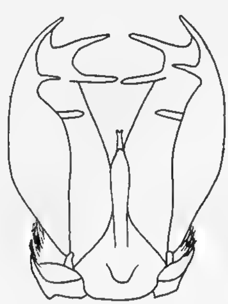


Figs 1, 2. Male genitalia in ventral view, Christmas Is. *Eurema* spp.: (1) *E. blanda blanda* (Boisduval); (2) *E. amplexa* (Butler) stat. rev.

(1932) and subsequent authors but deserves specific status. The tegumen is much smaller than that of *E. hecabe* and the uncus much longer, more slender and with the apical spines much smaller.

Appias paulina micromalayana Fruhstorfer

Appias paulina micromalayana Fruhstorfer: Pendlebury, 1935: 95; Gibson-Hill, 1947: 80.

Material examined.–1 ♂, Winifred Beach Rd, x.1983, L. Hill (ANIC).

There are records for Jan., Aug., Sep., Oct. and Dec.

FAMILY NYMPHALIDAE

Danaus chrysippus petilia (Stoll)

Limnas petilia (Stoll): Butler, 1900: 60.
Danaida chrysippus f. *petilia* (Stoll): Pendlebury 1933: 95; Gibson-Hill, 1946: 76.
Danus chrysippus petilia (Stoll): Ackery & Vane-Wright, 1984: 138.

There are records for Aug., Sep., and November.

Euploea climena macleari (Butler)

Vadebra macleari Butler, 1887: 522, fig. 4; Ridley, 1891: 129, 131; Butler, 1900: 61.
Euploea climena macleari (Butler): Fruhstorfer, 1910-1911 [1910]: 226-227; Talbot, 1922: xxx-xxxi; Gibson-Hill, 1947: 76; D'Abrera, 1982: 214, 215; Common & Waterhouse, 1972: 225 and 1981: 308.
Trepsichrois climena macleari (Butler): Ackery & Vane-Wright, 1984: 138; Pendlebury, 1933: 95.

Material examined.–25 ♂♂, 4 ♀♀, Christmas Is., 11, 12, 14, 15, 17, 19, 21, 23, 24, 27.i.1985, R. B. Lachlan (RBL). 2 ♂♂, 1 ♀, 1 km S.E. Jack's Hill, Field 25 Murray Hill and Drumsite, x.1983, L. Hill; 11 ♂♂, ½ ml. S. of Drumsite, 30.ix.1964, Grant's Well, 7, 10.x.1964, Anderson's Dale, 15.x.1964, Bean Hill, 15, 19.x.1964, T. G. Campbell; 1 ♂, South Point Rd, 11.x.1964, R. Bishop; 3 ♂♂, Christmas Is., 31.vii.1975, A. N. Gillison; 5 ♂♂, South Point, 31.vii.1975 and 7.viii.1975, A. N. Gillison and B. Bell (ANIC).

Taken in Jan., Mar., July to Nov. A common species usually found gathered in shady areas of forest. Gibson-Hill (1947) records that it "appears after rainy periods–never disappears entirely".

Euploea core corinna (W. S. Macleay)

Trepsichrois eleutho (Quoy): Pendlebury, 1933: 95-96; Gibson-Hill, 1947: 76.
Euploea core corinna Ackery & Vane-Wright, 1984: 138.

Material examined.–1 ♂, Flying Fish Cove, 11.vii.1961, G. F. Mees, WAM Reg. No. 85/1131 (WAM). 4 ♂♂, Settlement, 2.x.1964, T. G. Campbell; 1 ♂, 4 ♀♀, Flying Fish Cove, 30.vii.1975, A. N. Gillison (ANIC).

Specimens have been collected from June to October.

Melanitis ismene var. *determinata* Butler

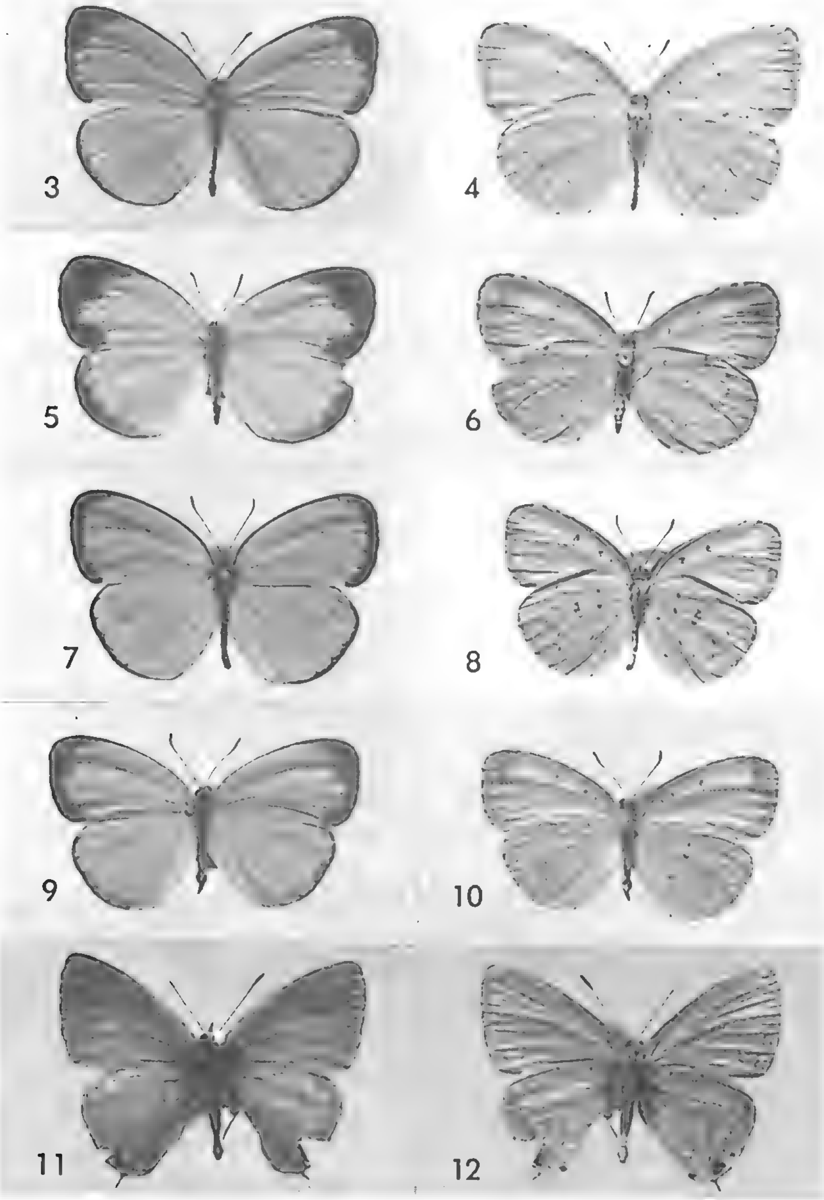
Melanitis ismene var. *determinata* Butler, 1900: 61; Gibson-Hill, 1947: 80.

Only a single female has been recorded by Butler (1900). It has not been taken since.

Polyura andrewsi (Butler)

Charaxes andrewsi Butler, 1900: 61-62, pl. IX, fig. 8.
Eriboea pyrrhus andrewsi (Butler): Pendlebury, 1933: 96-97; Gibson-Hill, 1947: 79
Polyura andrewsi (Butler): Smiles, 1982: 147, 148; D'Abrera, 1985: 384, 385.

Material examined.–1 ♂, 3 ♀♀, Christmas Is., 16, 18, 21, 31.i.1985, R. B. Lachlan (RBL).



Figs 3-12. (3-6) *Eurema blanda blanda* (Boisduval): 3, male upperside; 4, male underside; 5, female upperside; 6, female underside; (7-10) *Eurema amplexa* (Butler) **stat. rev.**: 7, male upperside; 8, male underside; 9, female upperside; 10, female underside (11-12) *Lampides boeticus* (L.): 11, male upperside; 12, male underside.

2 ♀♀, Works area, Settlement, iv.1964, D. Powell; 1 ♀, Hosmes Springs, no date, (probably viii.1975), A. N. Gillison (ANIC).

Specimens have been taken from August to June but probably occur all year round. It flies high, rapidly and rarely settles.

Hypolimnas bolina (L.)

Hypolimnas listeri Butler, 1888: 542-544; Ridley, 1891: 131.
Hypolimnas nerina, var. *listeri* Butler: Butler, 1900: 62-63.
Hypolimnas bolina listeri Butler: Pendlebury, 1933: 96; Gibson-Hill, 1947: 77-79.
Hypolimnas bolina (L.): Clarke & Sheppard, 1975: 242, figs 3, 5.

Material examined.–5 ♂♂, 34 ♀♀, Christmas Is., 11, 12, 13, 14, 15, 16, 17, 18, 19, 21, 22, 25, 27, 30.i.1985, R. B. Lachlan (RBL). 3 ♀♀, Christmas Is., (WAM Reg. No. 85/1125), Phosphate Hill, (WAM Reg. No. 85/1126), Blow Hole, (WAM Reg. No. 85/1127), 7.vii.1961, G. F. Mees, (WAM). 2 ♀♀, Dales Road and Drumsite, x.1983, L. Hill; 1 ♀, Settlement, 14.x.1964, D. Cooke; 5 ♀♀, Phosphate Hill, 10.x.1964, near Jedda Cave, 9.x.1964, Settlement, 2.x.1964; 1 ♀, Settlement, 14.x.1964, Dr K. Richardson; 9 ♀♀, Central Plateau, 10, 12, 15.viii.1975, A. N. Gillison (ANIC).

Specimens have been collected from July to March. The female of the species is highly polymorphic and a wide range of forms are encountered on the island.

Hypolimnas misippus (L.)

Hypolimnas misippus (L.): Butler, 1900: 62; Ridley, 1906: 150.
Hypolimnas misippus misippus (L.): Gibson-Hill, 1947: 79-80.

Material examined.–5 ♂♂, 3 ♀♀, Christmas Is., 11, 13, 16, 21.i.1985, R. B. Lachlan (RBL). 1 ♂, Christmas Is., 5.x.1969, S. Slack-Smith and A. Paterson, WAM Reg. No. 85/1130 (WAM). 1 ♂, Flying Fish Cove, 10.viii.1975, A. N. Gillison (ANIC).

There are records for Jan., Mar., Apr.-May, June. Aug. and October.

Hypolimnas anomala anomala (Wallace)

Hypolimnas antilope anomala (Wallace): Pendlebury, 1933: 96; Gibson-Hill, 1947: 77.
Hypolimnas anomala anomala (Wallace): Common, 1978: 41, 43, figs 9, 10.

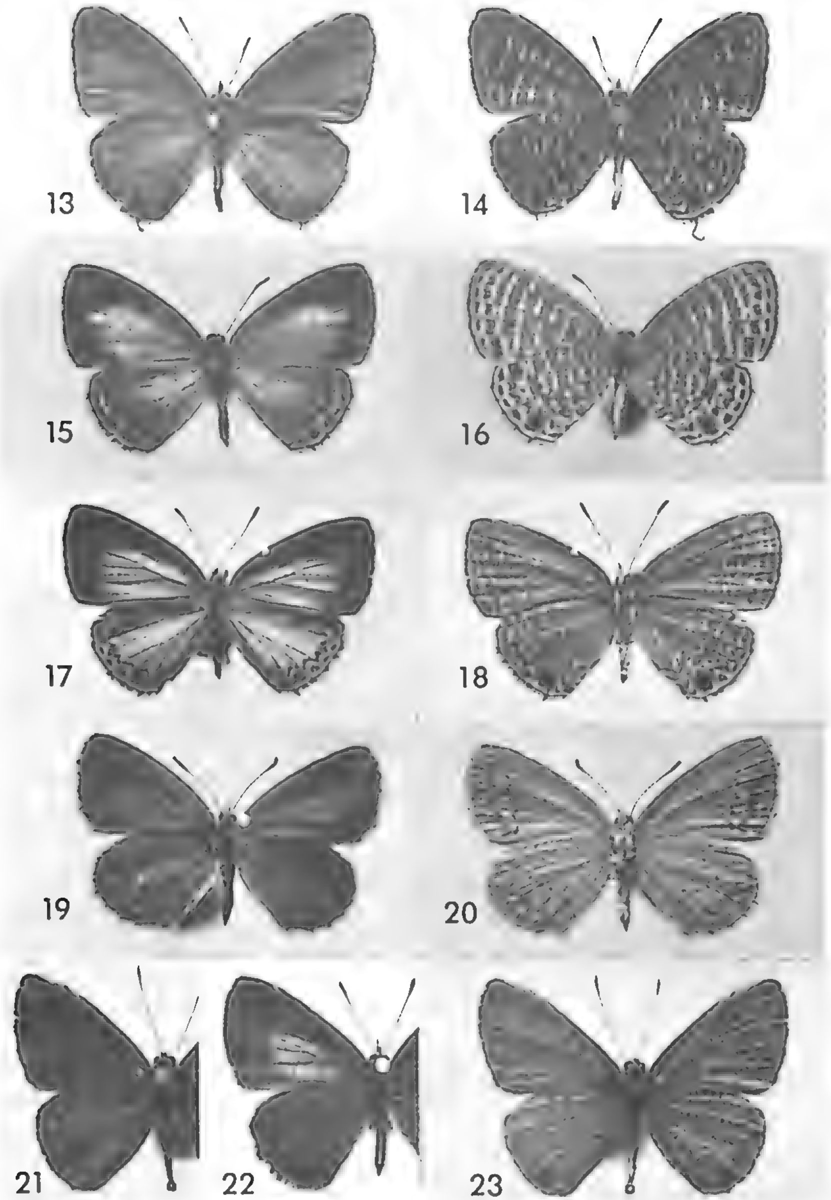
Material examined.–25 ♂♂, 8 ♀♀, Christmas Is., 13, 14, 15, 16, 17, 18, 19, 21, 22, 27, 31.i.1985, R. B. Lachlan (RBL). 1 ♂, Phosphate Hill, 7.vii.1961, G. F. Mees, WAM Reg. No. 85/1129 (WAM). 1 ♀, Settlement, 5.x.1969, S. Slack-Smith and A. Paterson, WAM Reg. No. 85/1128 (WAM). 7 ♂♂, 1 ♀, Central Plateau, 15.viii.1975, Flying Fish Cove, 30.vii.1975 and 10.viii.1975, West of Camp 5, viii.1975, A. N. Gillison; 1 ♀, Central Plateau near Field 22, 10.viii.1975, A. N. Gillison and B. Bell; 1 ♂, Flying Fish Cove, 31.vii.1975; A. N. Gillison and D. Auliffe (ANIC).

There are records for all months from May to Oct. and Jan. This species was very plentiful in January. The larvae are gregarious but despite large numbers of pupae being collected from a number of localities no adults emerged as they had all been parasitized.

Junonia villida (F.)

Junonia villida (F.): Butler 1900: 62; Ridley, 1906: 150.
Precis villida villida (F.): Pendlebury, 1933: 96; Gibson-Hill, 1947: 76-77.

Material examined.–6 ♂♂, 18 ♀♀, Christmas Is., 12, 13, 14, 15, 16, 18, 20, 21, 25, 27, 29.i.1985, R. B. Lachlan (RBL). 1 ♂, Central Area Workshop, x.1983, L. Hill; 1 ♂, Waterfall Pumping Station, 11.x.1964, T. G. Campbell; 5 ♂♂, Plateau Area, 10.viii.1975, Flying Fish Cove, 31.vii.1975 and 5.viii.1975, Christmas Is., viii.1975, A. N. Gillison (ANIC).



Figs 13-23. (13-16) *Nacaduba kurava* (Moore): 13, male upperside; 14, male underside; 15, female upperside; 16, female underside; (17-18) *Jamides bochus* (Stoll); 17, female upperside; 18, female underside; (19-20) *Zizina otis* (F.): 19, female upperside; 20, female underside; (21-23) *Prosotas dubiosa lumpura* (Corbet): 21, male upperside; 22, female upperside; 23, male underside.

This is a common species that "can be found all the year round" Gibson–Hill (1947). Adults prefer open areas of ground.

FAMILY LYCAENIDAE

Nacaduba kurava (Moore)

(Figs 13-16)

Material examined.–2 ♂♂, Christmas Is., 18, 27.i.1985, R. B. Lachlan (RBL). 1 ♀, Egeria Point Road, 12.x.1964, T. G. Campbell and R. Bishop (ANIC).

Previously unrecorded from Christmas Island.

Prosotas dubiosa lumpura (Corbet)

(Figs 21-23)

Nacaduba dubiosa lumpura Corbet, 1938: 141, fig. 20.

Material examined.–7 ♂♂, 10 ♀♀, Christmas Is., 11, 12, 13, 14, 15, 16, 25, 27, 28.i.1985, R. B. Lachlan (RBL). 1 ♂, 1 ♀, Plateau Area, 10.viii.1975, Tom's Ridge Rd, 14.viii.1975, A. N. Gillison; 1 ♂, 1 ♀, Settlement, 8.x.1964, South Point, 8.x.1964, T. G. Campbell, (ANIC).

Specimens have been taken in the months of Jan., Aug. and Oct.

Prosotas aluta (Druce)

Nacaduba aluta (Druce): Butler, 1888: 544; Ridley, 1891: 131; Butler, 1900: 63; Gibson-Hill, 1947: 79.

Specimens have been recorded for Mar., Oct. and Dec.

There is some doubt about the identity of this species. Butler (1900) and Gibson-Hill (1947) say it is common but their specimens which should be in BMNH cannot be traced; they are not included in the collection under this name or under any of the other lycaenid names listed in this paper.

Jamides bochus (Stoll)

(Figs 17, 18)

Material examined.–1 ♀, Tom's Ridge Rd, 15.viii.1975, A. N. Gillison (ANIC).

Previously unrecorded from Christmas Island.

Catochrysops panormus exiguus (Distant)

Material examined.–3 ♂♂, Tom's Ridge Rd, 15.viii.1975, Flying Fish Cove, 12.viii.1975, A. N. Gillison (ANIC).

Previously unrecorded from Christmas Island.

Lampides boeticus (L.)

(Figs 11, 12)

Material examined.–1 ♂, Tom's Ridge Rd, 10.viii.1975, A. N. Gillison (ANIC).

Previously unrecorded from Christmas Island.

Zizina otis (F.)

(Figs 19, 20)

Material examined.–6 ♂♂, 6 ♀♀, Christmas Is., 11, 12, 13, 14, 15, 17, 21, 23, 27.i.1985, R. B. Lachlan (RBL). 5 ♂♂, 1 ♀, Central Plateau, x.1983, L. Hill; 1 ♂, Flying Fish Cove, 30.vii.1975, A. N. Gillison (ANIC).

Previously unrecorded from Christmas Island.

Zizula hylax (F.)

Zizeeria gaika (Trimen): Pendlebury, 1933: 97; Gibson-Hill, 1947: 80. [*gaika* is now considered a junior synonym of *hylax*].

Material examined.–21 ♂♂, Christmas Is., 11, 12, 16, 21.i.1985, R. B. Lachlan (RBL, BMNH).

Specimens have been taken in January, August and September. A common species along roadsides and around cultivated areas.

Discussion

The rainforest that covers almost the entire island contains remarkably few plant species for such a tropical climate in contrast to the nearby Indonesian islands. Many of the butterfly food plant families are absent or poorly represented. Although a high proportion of Christmas Island's fauna is endemic only 2 of the 22 butterfly species are (viz. *Eurema amplexa* and *Polyura andrewsi*) and the number of butterfly species is very low compared to the Indonesian islands to the north.

No Hesperiidae have yet been sighted or taken on the island despite the fact that some suitable food plants exist including seven species of palms (one endemic) and the introduced grass, paspalum. However, in a total view, the variety of potential hesperiid food plants is low; there are few grasses (very common food plants for Asian hesperiids), few Acanthaceae, and a total lack of several other plant families that include known hesperiid food plants in Asia.

The only Papilionidae to be recorded is *Papilio demoleus* and this only since 1961. Again the number of potential food plants for papilionids is very low, the most suitable being several introduced citrus. There is only one natural Rutaceae, no Aristolochiaceae, no Annonaceae and no Monimiaceae.

Nearly all specimens taken by RBL were collected around the Settlement/Rocky Point area in places of exotic vegetation. The natural rainforest over the entire island was found to be almost devoid of butterflies, despite a thorough investigation of many ideal collecting locations. Only *Hypolimnas anomala* and *Nacaduba kurava* were found exclusively in the natural vegetation. Five species, *Hypolimnas bolina, Junonia villida, Polyura andrewsi, Euploea climena* and *Catopsila pomona* were widespread. No species was taken hilltopping.

Christmas Island is generally considered to be an extinct volcano at no time associated with any other land mass. This permanent isolation and the island's depauperate flora almost certainly accounts for its relatively poor butterfly fauna. It is very likely that some species have been accidentally introduced since settlement on exotic plants and no doubt other butterflies will be introduced in similar manner in the future. It is possible that there exist further butterfly species yet to be discovered on Christmas Island, particularly migrant species.

Acknowledgements

Col. John Eliot identified specimens of *Nacaduba kurava, Prosotas dubiosa, Zizula hylax* and *Zizina otis*; we express our appreciation to him and Dr P. R. Ackery for arranging these identifications. Dr E. S. Neilsen and Mr E. D. Edwards (ANIC) and Dr T. F. Houston (WAM) kindly loaned material from collections in their care and Dr Ackery made an extensive search for the Christmas Island specimens of "*Prosotas aluta*" in BMNH. We are grateful also to Mr E. D. Edwards for helpful comments on the manuscript.

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THE *SUNORFA* OF AUSTRALIA (COLEOPTERA: PSELAPHIDAE)

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Abstract

The Oriental genus *Sunorfa* Raffray is now known from Australia. It is compared with the other Australian member of the Tanypleurini, *Gnesion* Raffray, and two new species, *testacea* and *nigripes*, are described from northern Queensland.

Introduction

Sunorfa Raffray (1882) is widely distributed through the Oriental region. The subgenus *Sunorfoides* Raffray (1913) is restricted to the Seychelles, with the nominate subgenus known from Sri Lanka (Jeannel 1961) to the Fiji Islands (Park 1952). Despite the apparent centre of diversity being New Guinea, where 16 of the 24 known species are found, members of the genus have never been recorded from Australia. Two species belonging to this genus were recently collected in northern Queensland, and are different from the previously described species based on the figures and descriptions of Raffray (1903). These two species are here described as new.

Sunorfa is placed in the Tanypleurini, whose members are known entirely from the Gondwanaland continents. The only tanypleurine hitherto known from Australia is *Gnesion rufulum* Raffray (1900), described without any further indication of locality. *Gnesion* is similar in appearance to *Sunorfa*, but possesses dentate elytral humeri, two basal elytral foveae, and a distinct median fovea in the antebasal transverse sulcus of the pronotum. The elytra of *Sunorfa* lack dentate humeri, bear three basal foveae, and the pronotum lacks a median fovea in the antebasal transverse sulcus.

Sunorfa is characterized as follows: head with vertexal foveae, eleven antennomeres, antennal club formed by last three segments with antennomeres IX and X only slightly enlarged, eyes large; pronotum widest near anterior margin, antebasal transverse sulcus distinct between lateral foveae, median fovea lacking, prosternal foveae present, lateral mesosternal foveae present, single median mesosternal fovea, lateral mesocoxal foveae present, single median metasternal fovea; metasternal length equal to distance between metacoxae; elytra with three poorly defined basal foveae, only sutural stria present; abdomen with six visible segments, first segment with inner and outer lateral carinae distinct, of equal length, following segments lacking any trace of lateral margins; males with vertex modified, genitalia with two parameres.

Five paratypes of each new species are in the collection of the author (DSC). The holotypes and remainder of the paratypes are deposited in the

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Australian National Insect Collection (ANIC), CSIRO, Canberra. Illustrations are based on disarticulated cleared specimens on slides, and the features checked by comparison with specimens mounted on points. All measurements are in millimeters.

Key to Australian species

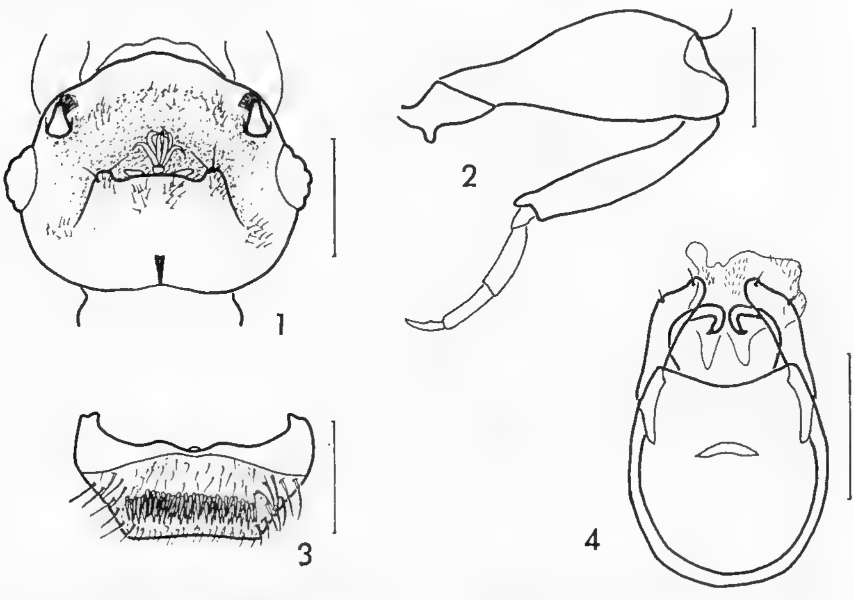
1. Punctures on elytra small, 8-10 punctures in line perpendicular from sutural stria to humeral angle; males with vertex deeply excavated anterior to tuberculate area, pronotum with setose callosities on antero-lateral margins . . . . *testacea* n. sp.

– Punctures on elytra large, 5-6 punctures in line perpendicular from sutural stria to humeral angle; males with vertex only slightly depressed anterior to median tubercle, pronotum lacking setose callosities . . . . *nigripes* n. sp.

Sunorfa (Sunorfa) testacea n. sp.

(Figs 1-4)

Length 1.02-1.14. Body yellow to orange-brown; head and prothorax sparsely and lightly punctate; elytra with dense light punctation, 8-10 punctures in line perpendicular from elytral suture to humeri, base with three poorly defined foveae.



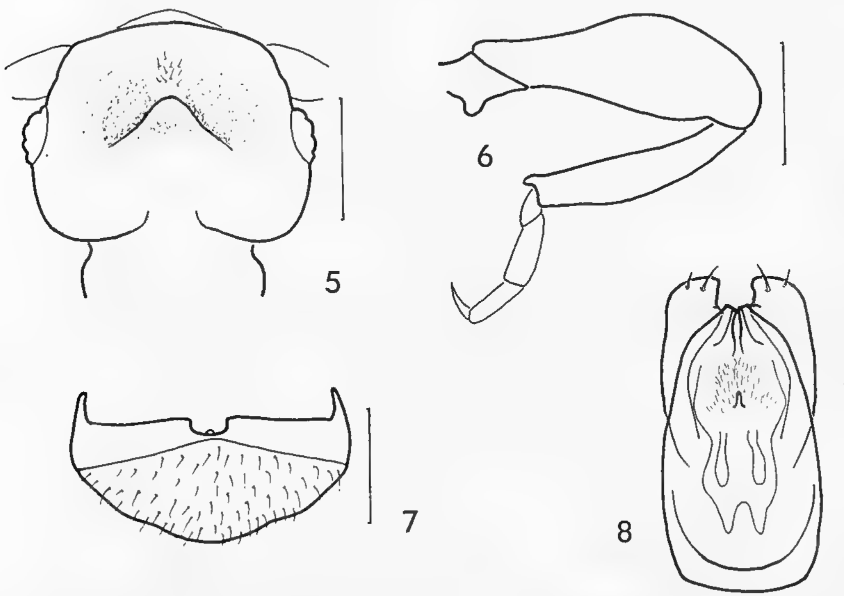
Figs 1-4. *Sunorfa testacea* n. sp., male: (1) dorsal view head; (2) anterior view left middle leg; (3) ventral view sternite VI; (4) dorsal view genitalia. Scale lines equal 0.1 mm.

Males with vertex deeply excavated between eyes, vertex protruding over excavation, median clump of flattened setae projecting dorsally at posterior margin of excavation, anteriorly curved hook originating above antennal bases; pronotum with small setose callosity on antero-lateral margins; mesotrochanters bearing blunt setate tubercle, mesofemora with dorsal circular impression at apex, mesotibiae with broad apical spur; sternite VI medially impressed, broadly truncate at apex, with transverse dense preapical zone of setae in impression. Genitalia with apex bearing two long recurved teeth; parameres apically narrowed.

Females with broad V-shaped impression extending anteriorly from vertexal foveae, area from impression to frons apex smoothly roughened. Lacking modifications of legs, sternite VI bluntly rounded, evenly setate.

Types.–HOLOTYPE male: Queensland, Upper Lankelly Creek, near Coen, 11.vi.1971, G. B. Monteith, rainforest (ANIC). PARATYPES: 8 ♂♂, 3 ♀♀, same data as holotype (ANIC, DSC).

Discussion.–The lighter colour and small dense elytral punctures will readily separate this species from *nigripes.* The male sexual features of the head, pronotum, and mesofemora, and the deep V-shaped vertexal impression of the female, can also be used to segregate the two species.



Figs 5-8. *Sunorfa nigripes* n. sp., male: (5) dorsal view head; (6) anterior view left middle leg; (7) ventral view sternite VI; (8) dorsal view genitalia. Scale lines equal 0.1 mm.

Sunorfa (Sunorfa) nigripes n. sp.

(Figs 5-8)

Length 1.02-1.08. Body red-brown to brown; head and elytra with sparse coarse punctures, elytra with 5-6 punctures in line perpendicular to elytral suture from humeri; pronotum with moderate sparse punctation; elytra with 3 basal foveae same size as elytral punctures.

Males with vertex slightly raised at middle, projecting anteriorly as narrow shelf, area antero-medial to vertexal foveae flattened; mesotrochanters with broad ventral tubercle, mesotibiae with broad apical spur; sternite VI with apex broadly rounded, disc lightly convex, evenly setate. Genitalia with apex narrowly truncate, divided but lacking teeth; parameres broad to apex.

Females with vertex lightly impressed antero-medially from vertexal foveae, impression interrupted at middle; legs lacking modifications, sternite VI similar in form to that of males, not as densely setate.

Types.—HOLOTYPE male: Queensland, 16.06S 145.28E, near Cape Tribulation, 50 m, 20.vi.1971, Taylor and Feehan, rainforest, Berleseate ANIC 326 (ANIC). PARATYPES: 1 ♂, 8 ♀♀, same data as holotype (ANIC, DSC); 1 ♂, same data except, 16.06S 145.27E, 21.vi.1971, rainforest, Berleseate ANIC 323 (ANIC); 1 ♀, 16.07S 145.25E, Noah Creek, 50 m, 12.vi.1971, Taylor and Feehan, rainforest, Berleseate ANIC 321 (ANIC); 1 ♂, Tully Falls National Park, 750 m, 2.vii.1971, Taylor and Feehan (ANIC); 1 ♂, Eacham National Park, 760 m, 1-7.x.1972, R. W. Taylor (ANIC); 1 ♀, Iron Range, 12.43S 143.48E, 15.vi.1971, Taylor and Feehan, rainforest, Berleseate ANIC 308 (ANIC).

Discussion.—Distinct by the darker colour and sparse coarse elytral punctures. The male vertex is barely impressed and tuberculate, and the female vertex only lightly impressed for a short distance antero-medial to the vertexal foveae. The head of the specimens from Tully Falls and Eacham National Parks are markedly densely punctate, but the male characters and genitalia are identical with the specimens from Cape Tribulation.

Acknowledgements

I would like to thank Claude Besuchet, Museum d'Histoire Naturelle, Geneva, for confirming the generic placement of these species. J. F. Lawrence, CSIRO, Canberra, assisted by the loan of the specimens. J. F. Burger and R. M. Reeves, University of New Hampshire, deserve my appreciation for reviewing the manuscript.

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NEW AND INTERESTING BUTTERFLY RECORDS FROM NORTHERN QUEENSLAND AND TORRES STRAIT

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Introduction

Records of interest and notes on the biology of some of the butterflies of north Queensland and Torres Strait are presented below.

Family Hesperiidae

Netrocoryne repanda expansa Waterhouse.–Philip Hill, Iron Range, October, 1978. Previously known as far north as Mt White, Coen, October, 1976, Sands (Monteith & Hancock, 1977). This record extends its range 130 km further north. I have found larvae of this species at Coen and Iron Range on a number of species of Lauraceae.

Mimene atropatene (Fruhstorfer).–Previously known only from two specimens taken in May 1973 and August 1977 at Iron Range (Miller 1975; Monteith & Hancock, 1977). Seven specimens have been taken between March and June, 1980 to 1983. This species appears to be more common in the wetter months, four of the seven specimens were taken in March.

Family Papilionidae

Protographium leosthenes leosthenes (Doubleday).–Philip Hill, Iron Range, December, 1974. Not previously known from Iron Range, the closest record being from specimens taken by Moulds on Mt White, Coen, January, 1964, (Monteith & Hancock, 1977). Males of this species were hilltopping with males of *Graphium aristeus parmatum* (Gray).

Eleppone anactus (W. S. Macleay).–Many specimens sighted at Bamaga in May, 1985. Kuranda, 950 km to the south, is the former northern-most locality for this species (Common & Waterhouse, 1981).

Papilio aegus aegus Donovan.–Single specimens of form *beatrix* were taken at Iron Range in August 1983, Bamaga in May 1985 and Iron Range in December 1985. The Iron Range female of 1983 was induced to oviposit and female progeny of this and its succeeding generations were two-thirds *beatrix* and one-third normal form It is interesting that on Murray Island where the race *ormenus* is found flying with *Taenaris artemis jamesi* Butler, the majority of females observed were form *beatrix*. Progeny of two normal females from Murray Island produced no form *beatrix*.

Family Pieridae

Delias nysa nivira Waterhouse and Lyell.–Usually regarded as a rare butterfly, numbers of specimens of this subspecies have been taken on the Tozer Range during the winter months.

Pieris rapae rapae (Linnaeus).–One specimen taken, but not kept, Mt White, Coen, April, 1983. Previously unknown north of the Atherton Tableland (Common & Waterhouse, 1981), 400 km to the south.

Family Nymphalidae

Hypolimnas anomola albula (Wallace).—1 female, Iron Range, March 1983, 1 male, Iron Range, December 1985. Known previously from two males, one at Port Darwin and the other at Cape York (Gibb, 1977; Common & Waterhouse, 1981). The Iron Range records extend its range 400 km south from Lockerbie and is evidence for the species being a resident of Australia and not a vagrant.

Hypolimnas antilope (Cramer).—1 female, Yorke Island, March 1986. Previously known only from Murray Island within Australian limits. This female deposited a mass of eggs on *Pipturis argenteus* (Forst. f.) Wedd. Urticaceae, on which she was confined. These proved to be infertile.

Family Lycaenidae

Hypochrysops cleon Grose-Smith.—1 female, Gordon Ck bridge, Iron Range, July 1981. This is probably the first female taken in Australia.

Jalmenus eichorni Staudinger.—Many specimens taken Laura, August 1981, Mt Garnett, January 1983, Mt Molloy, June 1985. The previous southern-most record of this species was Trevarthen Creek, 27 km south of Cooktown (Common & Waterhouse, 1981). The Mt Garnett record extends its distribution 230 km further south.

Petrelaea dana (Niceville).—Many specimens were taken on Yorke Island, March 1986 and a single specimen on Darnley Island, April 1986. This is usually regarded as a rare species.

Jamides amarauge Druce.—Many specimens Yorke Island, March 1986. Three specimens of this species were taken on Thursday Island, April 1986, extending its range 130km westward from the islands of eastern Torres Strait.

Catochrysops amasea amasea Waterhouse and Lyell.—1 male, Iron Range, August 1981. On the Australian mainland known previously from Cape York (Common & Waterhouse, 1981), 400 km north of Iron Range.

Acknowledgements

I wish to thank Dr G. B. Monteith, Queensland Museum, Brisbane, and Mr E. D. Edwards, Division of Entomology, C.S.I.R.O., Canberra, for identifying specimens.

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THE LIFE HISTORY OF *CROITANA ARENARIA* EDWARDS, 1979 (LEPIDOPTERA: HESPERIIDAE: TRAPEZITINAE)

By Andrew Atkins* and C. G. Miller†
* 45 Caldwell Avenue, Dudley, New South Wales 2290
† 35 Uralba Street, Lismore, New South Wales 2486

Abstract

The early stages and biology of the proeidosine skipper *Croitana arenaria* Edwards from central Australia are described and figured.

Introduction

Edwards (1979) described two species of skipper (*Croitana arenaria* and *Croitana aestiva*) from the arid zone of the Northern Territory around Alice Springs and the Plenty River areas. The remaining, and type species of the genus, *Croitana croites* (Hewitson), is found in coastal and near coastal areas of south-western Western Australia.

The type series of *Croitana arenaria* was collected by Edwards in September and October, 1978 from five localities within 60 km of Alice Springs. The first example of the species was collected many years ago at Hermannsburg, 116 km W. by S. of Alice Springs.

In the first week of February, 1987, the authors collected eggs, larvae and a pupa of *C. arenaria* from several localities in and around Alice Springs, and these were reared to adults in New South Wales.

Life History

Foodplant. Enteropogon (*Chloris*) *acicularis* (Lindl.) Lazar., family Poaceae.

Egg (Fig. 1). Diameter 1 mm, hemispherical, pale green to pearl white, with 13-16 ribs.

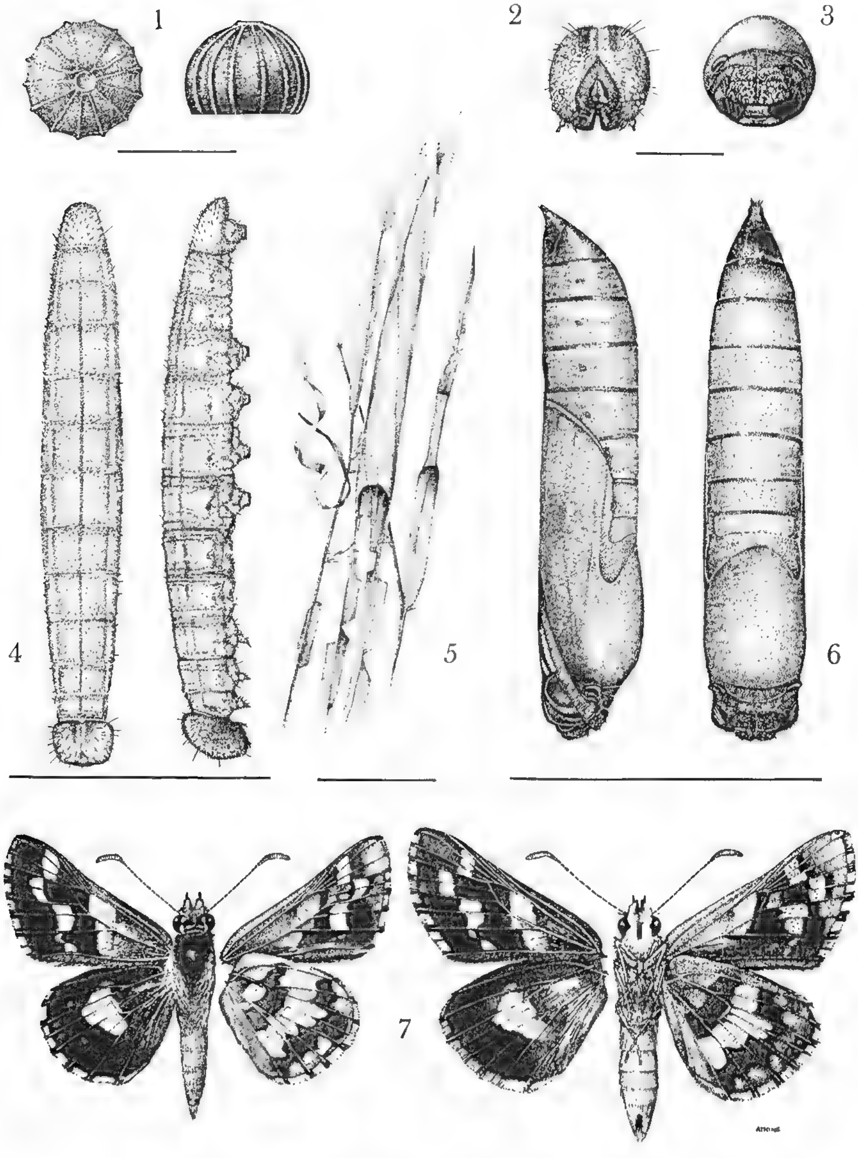
Larva (Figs 2, 4). First instar 4 mm long; head and prothoracic plate shiny black; body pale semi-translucent yellow. Second to final instar 5 mm-24 mm long, head pale yellow-brown with variable darker/dorsal markings, mouthparts brown-black; body pale green to light brown with lateral areas bordering a pale dorso-lateral band and a dark dorsal line.

Pupa (Figs 3, 6). Length 12-15 mm, yellow-brown with dark brown anterior and frons area. Pupal cap rugose, with shallow transverse and vertical furrow.

Biology

The egg is laid on the upperside of a leaf of the foodplant. The first instar larva rolls together the edges of the leaf blade and secures them with silk. The larva rests in this tube shelter, facing towards the stem of the grass blade. The edges and distal part of this leaf are eaten. A similar but larger shelter is made by the second instar larva.

Later instars construct a generally downward-facing tent-like shelter from two or more leaves. This structure is supported by strongly-woven, uneaten ribs of the leaf blade (Fig. 5). The larva eats at dusk and again at dawn. Supporting and nearby leaves are eaten, leaving chisel shaped cuts to the edges of the leaves. The larva is generally active, securing with silk leaves



Figs 1-7. Life history of *Croitana arenaria* Edwards: (1) egg; (2) final instar larval head; (3) pupal head; (4) third instar larva; (5) pupal and first instar shelters; (6) pupa; (7) adult male, upperside and underside and adult female, upperside and underside. Scale-bars (1) = 1 mm. (2), (3) = 2 mm; (4), (5), (6), (7) = 10mm.

and stems to provide 'pathways' to fresh leaf growth. When disturbed the larva vigorously waves its head from side to side. Several late instar larvae produced small ichneumonid parasites.

Pupation occurs, head downward, in the final instar larval shelter and adults emerge 12-16 days later.

Notes

Adults of this skipper were not observed in the field, but the presence of all stages of the life history in February, after good rainfall, suggests that *Croitana arenaria* flies sporadically throughout the warmer months of the year if adequate rains have fallen.

The foodplant, commonly known as 'Windmill grass' or 'Curley grass' grows locally in compact red sandy loams on open plains or in swales between low hills or near dry river beds. Larvae were found in these situations, both close to the suburbs of Alice Springs, and from 49 km E. to 26 km W. of that city. Two larval colour-forms were found. In the early instars a brown form, generally occuring on foodplants growing in open areas, was prevalent, however a green form was found usually on foodplants growing in the shade of trees and bushes. However, later instars are all brown irrespective of their situation.

Enteropogon acicularis is widespread in the central sub-arid and arid regions of Australia and it is reasonable to expect that *Croitana arenaria* may have a considerably greater distribution than so far recorded.

Acknowledgement

The authors are grateful to the staff of the Arid Research Institute, Alice Springs, for help in identifying the foodplant.

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BOOK REVIEW

Australia's butterflies by Peter Wilson. 1987. 64 pp., illustrated with 16 colour plates. Kangaroo Press, P.O. Box 73, Kenthurst, N.S.W. Price $14.95.

This soft covered book is written specifically for the layperson. Eighty two of the more common butterfly species are discussed and illustrated, with excellent colour photographs taken in the wild.

The Introduction provides an account of butterfly biology, nomenclature, collecting and photography. The main text includes brief descriptions of the five major families occurring in Australia and notes on the species illustrated. Details on species distribution are sketchy. Common names are given prominence and technical terms are minimised.

The photographs are generally of a high standard and grouped together on 16 colour plates. However, some photographs hide details useful for identification. The index could have been expanded to include separate listings of specific names which are given only as adjuncts to generic names. It is disappointing that the publisher has shown little imagination in text layout with indistinct headings and cramped margins.

At $14.95 this book provides a useful introduction for the novice collector or observer of 'Australia's butterflies'.

Stephen & Bronwyn UNDERWOOD

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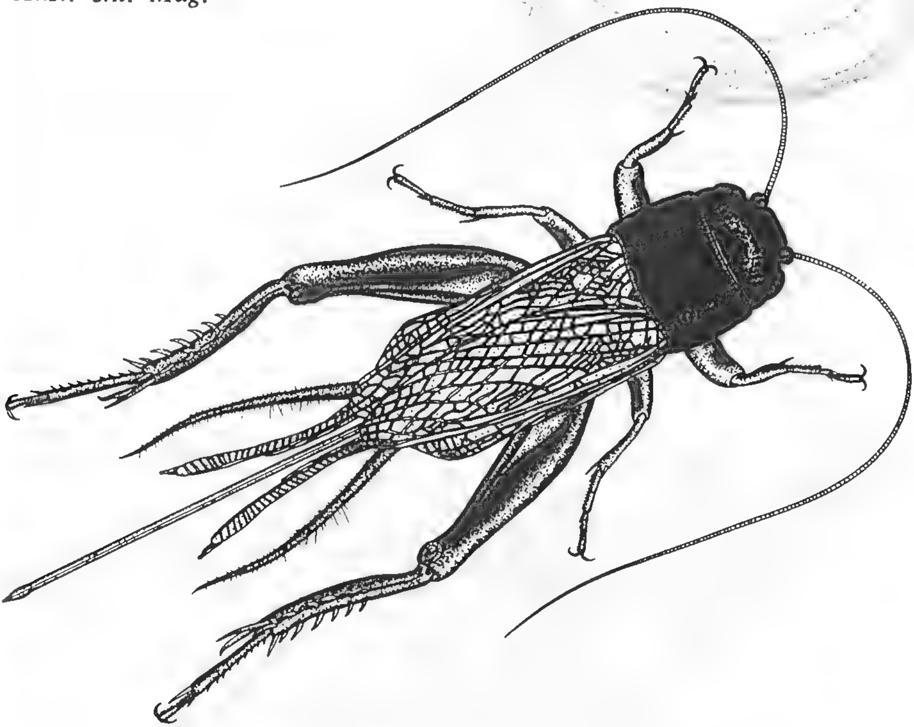

Edited by M. S. Moulds

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COVER

Illustrated by Alan Westcott.

Black field cricket, *Teleogryllus commodus* (Walker). This native Australian insect is sometimes a serious pest of pastures and crops in Victoria, New South Wales and New Zealand. Damage is caused by adults and late stage nymphs chewing on leaves and stems of young plants at night. Plagues originate in grasslands and pastures, the crickets swarming at dusk during warm, calm weather.

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EDITORIAL

In the first issue of *Aust. ent. Mag.* published more than 15 years ago, I wrote an editorial which read "In presenting this first issue of the *Australian Entomological Magazine* I hope that it will meet the needs of both amateur and professional entomologists who have made original observations or carried out researches which, whilst not extensive, are nevertheless of interest and should be made known to others interested in our insects. This journal should provide an outlet for such and encourage authors to publish much information that is now being lost."

This present issue will be the last falling under my editorship. I believe the aims and hopes with which I set out have been fulfilled and that the establishment of the journal has been more than justified. Some 180 authors have published in the first 14 volumes. Although many of these authors have been professional entomologists a considerable proportion have been amateurs and their contributions have been significant. There is little doubt that many of the papers appearing in *Aust. ent. Mag.* would never have been published if *Aust. ent. Mag.* had not existed, and many of the amateurs would never have set out on the road to publication without it.

The past success of *Aust. ent. Mag.* has been, in great part, due to those who have refereed papers; never has a referee refused assistance and so often this has been a time-consuming and thankless task. I sincerely thank all involved.

The decision to relinquish the editorship and production of *Aust. ent. Mag.* has not been an easy one for either me or my wife, Barbara. It has been so much a part of our lives for so long; we will always remember checking the proofs of the second issue the night before our wedding! After 15 years we feel that the time has come for us to hand over control of *Aust. ent. Mag.* to others and do some other things which we have not had time to do in the past. This does not mean that we are leaving entomology, far from it, but we would like to travel more and develop our other entomological interests.

Barbara and I have enjoyed producing *Aust. ent. Mag.* In doing so we hope that we have made some contribution to Australian entomology. We trust that you as a subscriber and author have benefited from the journal. The next issue begins a new era in the production of *Aust. ent. Mag.* and I can see no reason why the next 15 years should not be even more successful.

MAX MOULDS
Founding Editor

BIOLOGICAL OBSERVATIONS ON THE MUD-DAUBER WASP *SCELIPHRON FORMOSUM* (F. SMITH) (HYMENOPTERA: SPHECIDAE)

By E. McC. Callan
13 Gellibrand Street, Campbell, Canberra, A.C.T. 2601

Abstract

Observations were made on the nesting biology of the mud-dauber wasp *Sceliphron formosum* (F. Smith). The nest, mud collection, cell construction and provisioning are described. Cells were provisioned almost exclusively with spiders of the family Salticidae.

Introduction

The cosmopolitan wasp genus *Sceliphron* Klug is represented in Australia by the endemic *S. laetum* (F. Smith) and *S. formosum* (F. Smith), and by the North American *S. caementarium* (Drury), established only in the Brisbane area. Naumann (1983) gave an account of the biology of *S. laetum*, with a key to *Sceliphron* and maps of distribution in Australia, and Smith (1979) discussed population dynamics.

S. formosum was assigned by van der Vecht and van Breugal (1968) to the subgenus *Prosceliphron*, which contains about a dozen species, restricted to the Old World. Little is known of the biology of this subgenus. Bohart and Menke (1976) listed *S. formosum* from Australia, Papua New Guinea and Indonesia (Ceram and Ternate). In Australia it is less widespread and rarer than *S. laetum*, reaching as far south as Canberra, Australian Capital Territory.

In the tropical part of its range *S. formosum* nests no doubt throughout the year. In Canberra, where it nests only during the summer, I have observed females collecting mud and building a nest, on which the following account of nesting biology is based.

Nest
(Fig. 1)

The nest of *S. formosum* when first observed on 29 December 1984 comprised a row of 4 contiguous mud cells, 3 sealed and provisioned and one built, but left open and empty. This cell was stored and closed on the following day. On 31 December a fifth cell was constructed and next day provisioned and sealed. The site of the nest was at a height of 1.5 m on a wall inside the garage of my house in Canberra. The door was left open during the day and the nest was well illuminated by sunlight entering through a nearby window.

The completed nest of 5 cells was 52 mm long and 35 mm wide. It was not covered by an extra layer of mud (crepissage) applied after completion of the cells. Individual cells were 32-35 mm long and 9-10 mm wide. Each cell was amphora-shaped with a smooth external surface and its own entrance, 5.5 mm in diameter, which was sealed by the female on completion of provisioning. The wasp had changed the mud source during nest construction,

as the first 3 cells were grey in colour and the others reddish brown. Naumann (1983) figured a 3-celled nest, from which adult wasps had emerged, on the wall of a house at Jabiru, Northern Territory.

Mud collection

Females of *S. formosum* were observed collecting mud in hot, sunny weather between 1400 and 1500 hr on 15 March 1981 and 23 December 1982 from a wet mud patch in my garden. The mud was a bare area of soil on the edge of the lawn deliberately kept moist by watering, and attracted various mud-building aculeate wasps. The female formed the mud into a pellet, about 2 mm in diameter, using the forelegs and mandibles. Mud collection required about 60 sec., and was accompanied by a high-pitched buzzing, which was also emitted when pellets were deposited in cell construction. The mud pellet was held by the mandibles during flight to the nest site. Although an attempt was made to follow the flight path of females, nests were not discovered at this time.

Cell construction

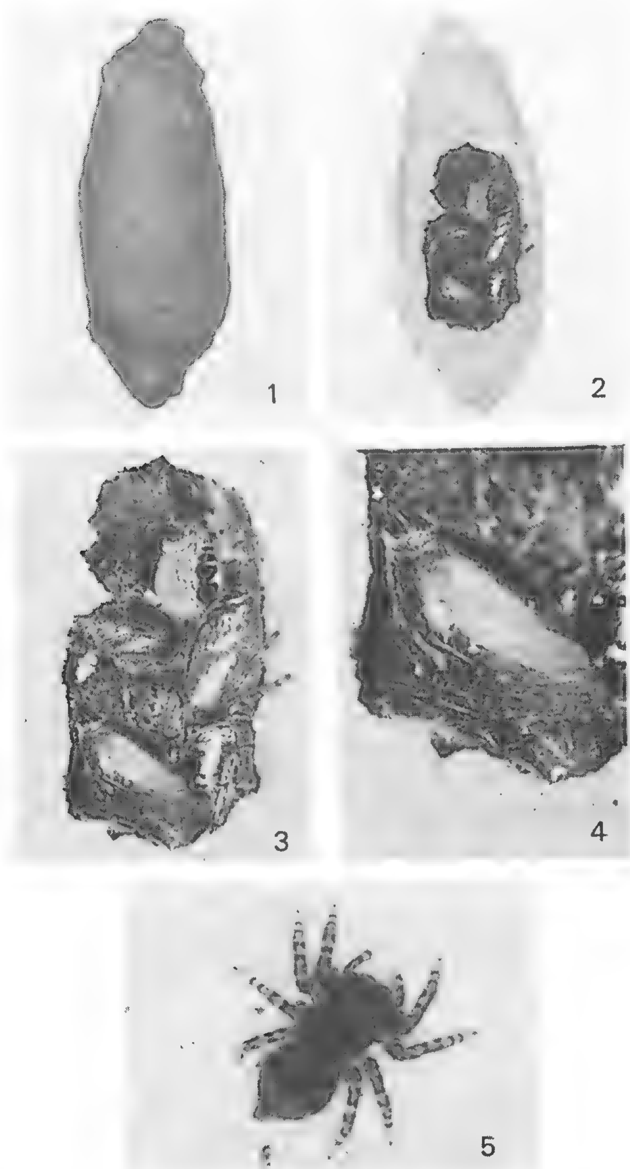
The construction of a cell was observed on 31 December 1984. Building extended from about 1330 to 1530 hr, taking some 2 hr to complete the cell, which was left open overnight. During the last hour of construction 15 mud-carrying flights were observed, suggesting that about 30 mud pellets were required to build the cell. The mud source was not located, but was doubtless nearby, as only a short time was spent in gathering mud and carrying it to the nest.

An average of 45 sec. (range 40-60 sec.) was spent daubing mud on the cell, and 120 sec. (range 60-180 sec.) collecting mud and transporting it to the cell, giving an average pellet cycle of 165 sec. The high-pitched buzzing emitted by *S. formosum* when depositing mud-pellets was not as loud as that produced by *S. laetum.*

During cell construction the female left the nest once for 6 min. and on another occasion for 14 min., but both those absences have not been included in the average time for collecting and carrying mud to the cell. During these longer periods the female probably visited flowers to feed on nectar or may have been basking.

Provisioning
(Figs 2-4)

Cells were provisioned with spiders, and storing the cell built on the previous day was observed on 1 January 1985. Provisioning commenced before 1200 hr and was completed by 1400 hr. The female oviposited on the first spider placed within the cell. Oviposition was not observed, but must have occurred before 12 noon. After depositing the spider, the female laid the egg, 2.8 mm in length, attached to the ventral surface of



Figs 1-5. *Sceliphron formosum* (1) sealed mud cell, 33 mm long and 9 mm wide; (2) cell removed from wall with stored spider prey; (3) salticid spider prey with egg on first spider stored; (4) egg, 2.8 mm long and 0.8 mm wide, attached to opisthosoma of prey; (5) salticid spider prey. [Photos by J. P. Green].

the opisthosoma. Subsequently, spiders were collected and stored one by one until the cell was filled.

Hunting flights averaged 175 sec. (range 120-300 sec.). The female spent about 60 sec. (range 45-120 sec.) in the cell from returning with prey to starting on the nest hunting flight. This gave an average provisioning cycle of 235 sec., and suggested the exploitation of a ready source of prey nearby. As 18 spiders were stored in the cell, there must have been as many provision flights. The female occasionally spent longer periods away from the cell, possibly experiencing difficulty in finding prey or the time may have been spent in feeding or basking.

Final closure of the fully provisioned cell with a thick plug required 3 mud pellets and took about 30 min. Temporary cell closure with a thin mud plug has been observed in Canberra in *S. laetum*, when, with the onset of darkness, provisioning was not completed. This was not observed in *S. formosum*, but occurs no doubt under the same conditions.

Prey
(Fig. 5)

In all 80 spiders were removed from the 5 cells in the nest, 12-20 spiders being stored per cell. The pooled spiders comprised 74 Salticidae, 4 Miturgidae (*Miturga* sp.), 1 Araneidae (*Araneus* sp.) and 1 Heteropodidae (*Isopoda* sp.). The Salticidae included both adults and juveniles and were represented by 3 species. The predominant prey comprised 63 sp. A, probably *Saitis taeniatus* Keyserling. Other salticid prey were 6 sp. B and 5 sp. C of indeterminate genera. The non-salticid prey were juveniles, identifiable to genera but not to species.

No observations were made of *S. formosum* actually capturing prey. Hunting evidently took place near the nest site, the salticid identified provisionally as *taeniatus* being found abundantly on the walls of my house.

Discussion

Naumann (1983) reported nests of *S. formosum*, protected from rain but well illuminated, on the walls of houses at Jabiru, Northern Territory. The *S. formosum* nest in Canberra was also in a sheltered, well illuminated situation. By contrast, nests of *S. laetum* are usually found in shaded or dimly lit sites protected from direct sunlight. These nests have been built several times in the same Canberra garage as contained the *S. formosum* nest, but invariably in a poorly illuminated situation in the angle between wall and ceiling. The nest structure of *S. formosum* in Canberra was similar to that described by Naumann (1983). Unlike nests of *S. laetum* and related species, *S. formosum* nests are not covered with an extra layer of mud.

Nesting behaviour in *Sceliphron* comprises the pellet cycle, starting with flight from the nest and ending after adding the collected mud pellet to the cell, and the provisioning cycle starting similarly and ending with the collected prey being deposited in the cell. In *S. formosum* the pellet cycle was

2.75 min. Freeman and Johnston (1978) reported for *S. assimile* Dahlbom a longer and Naumann (1983) for *S. laetum* a shorter pellet cycle, the distance of the mud source from the nest accounting no doubt for the variation. In *S. formosum* the provisioning cycle was about 4 min., much shorter than that reported in *S. assimile* and *S. laetum* (> 9 min.). This undoubtedly reflected the ready source of prey (Salticidae) available on nearby walls for *S. formosum*, and the greater difficulty in finding prey (Araneidae) for the other species.

The prey of *S. formosum* comprised almost exclusively spiders of the family Salticidae. Much the most abundant species was provisionally identified as *Saitis taeniatus*, which occurs commonly on the walls of my house. By contrast, the prey of *S. laetum* and its allies consists mainly of Araneidae, but may occasionally include spiders of several other families. In over 100 records of prey from *S. laetum* nests built in my garage all spiders were Araneidae, predominantly *Eriophora biapicata* (L. Koch), *Araneus heroine* (L. Koch) and *A. urquharti* (Roewer).

Sceliphron is essentially an opportunist in regard to prey and captures readily available spiders near the nest site. *S. formosum* apparently hunts for Salticidae on walls, while *S. laetum* takes Araneidae on their orb-webs. A marked degree of prey-specificity permits these related wasps to nest in close proximity, each exploiting a different family of spiders without competing for food resources.

Acknowledgements

I am grateful to Dr I. D. Naumann for criticism and advice. Dr Valerie T. Davies and Mr R. J. Moran kindly identified the spider prey, and Mr J. P. Green took the photographs.

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THE LIFE HISTORY OF *HYPOCYSTA ANGUSTATA ANGUSTATA* WATERHOUSE & LYELL AND *HYPOCYSTA IRIUS* (FABRICIUS) (LEPIDOPTERA: NYMPHALIDAE: SATYRINAE)

By G. A. Wood
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Abstract

The early stages of *Hypocysta angustata angustata* Waterhouse & Lyell and *Hypocysta irius* (Fabricius) are described. Comments is made on the number of larval instars for each species; *H. irius* is the first Australian species to be reported with only four instars.

Introduction

The black and white ringlet, *Hypocysta angustáta angustata* Waterhouse and Lyell, is a species of the rainforest of the Claudie River to Coen area, Cape York Peninsula (Common and Waterhouse, 1981). The northern ringlet, *Hypocysta irius* (Fabricius), is distributed along the east coast of Australia from Grafton to Cape York. It flies commonly along the margins of rainforests, to which it is confined. The larvae have been reported to feed on *Imperata* and other coarse grasses (Poaceae) (Common and Waterhouse, 1981).

Females of both species from Iron Range, northern Queensland, were confined with the various grasses found along rainforest margins in the area, Ova were deposited on *Tetrarrhena* sp. (Poaceae) and adults were successfully raised on this food plant.

Hypocysta angustata angustata Waterhouse and Lyell

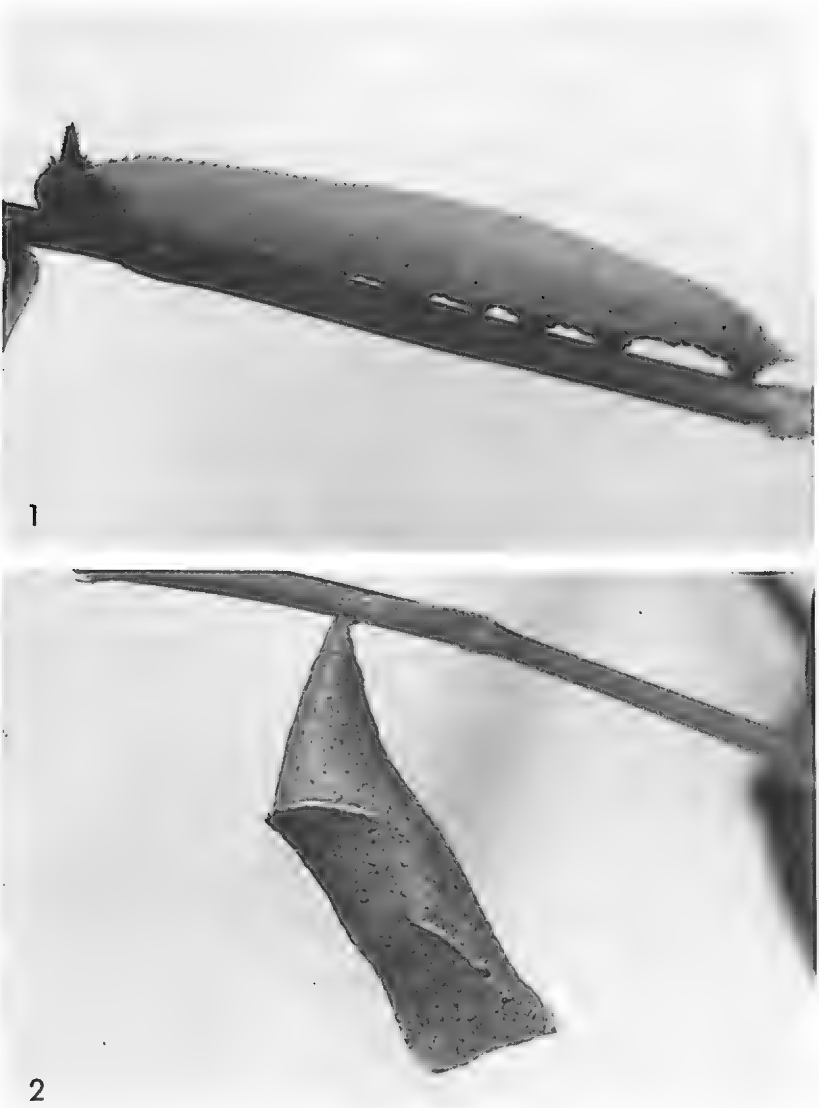
Food plant. Tetrarrhena sp. (Poaceae), wire grass.

Ovum. 0.6 mm diameter. Shiny pale green, smooth, spherical. Deposited singly beneath the leaves of the food plant.

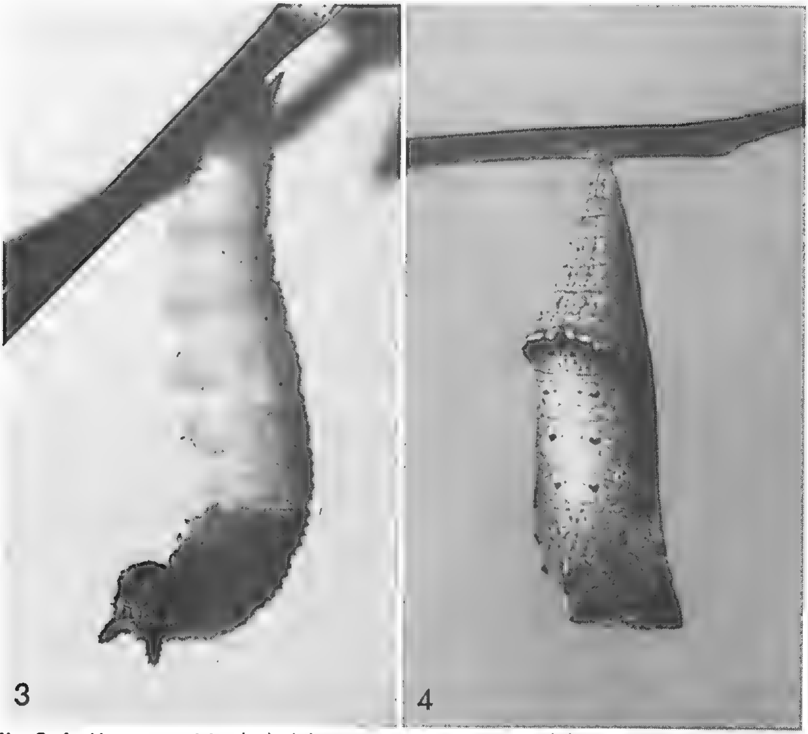
First instar. Length 2.5 mm. Head black, smooth, shiny, round, nearly flat dorsally, with a very shallow median depression and minute black hairs. Body greenish-white, smooth, with pale hairs.

Third instar. Length 6 mm. Head with short, blunt dorsolateral horns and covered with small conical projections and short hairs. Dull brown with apexes of horns and two spots on each side of head orange. Body green, with longitudinal strips of dense, very short setae, giving it a striped, rough appearance. Anal segment bifurcate.

Fifth instar (Fig. 1). Length (without processes) 15 mm. Head dull brown, orange spots in third instar developed to conical projections, outer side of horns and sides of head orange, covered with short hairs. Head with median orange strip on upper half, two orange spots between horns and dull orange patches on lower half of face. Body as in third instar, greenish-brown, later turning dark green, anal processes (length 0.8 mm) brown above, spiracles black.



Figs 1, 2. *Hypocysta angustata angustata* Waterhouse & Lyell: (1) fifth instar larva; (2) pupa, lateral view.



Figs 3, 4. *Hypocysta irius* (F.): (3) larva in prepupal phase; (4) pupa, dorso-lateral view.

Pupa (Fig. 2). Length 12 mm. Pale brown with darker brown markings, angular, with short lateral projections at anterior end a transverse ridge on abdomen, a longitudinal dorsal ridge on thorax and a ridge along each wing case. Abdominal ridge with anterior surface dark brown, thoracic ridge with brown patch at apex and ridge on each wing case brown on dorsal surface. Spiracles dark brown. Suspended by cremaster.

Notes. Eggs laid in late December produced adults in 45 days. Ova hatched in four days, the larval stage lasted 33 days, and the pupal period was eight days.

Larvae shelter beneath the leaves or on the stem of the food plant and feed both during the night or day.

Pupation occured on the food plant.

Hypocysta irius (Fabricius)

Food plant. Tetrarrhena sp. (Poaceae), wire grass.

Ovum. 0.8 mm diameter. Shiny yellow, smooth, spherical. Deposited singly on the underside of leaves of the food plant.

First instar. Length 3 mm. Head black, smooth, shiny, with a pair of short, blunt, dorso-lateral horns and minute black hairs. Body cream, smooth, with minute white hairs.

Second instar. Length 5 mm. Head dull black, covered with minute conical projections and minute hairs. Perimeter of head with three small pairs of pointed orange projections, one pair between the horns and the others laterally. Body green, with longitudinal strips of dense, very short setae, giving it a striped, rough appearance. Anal segment with short, pointed projections.

Third instar. Length (without projections) 8 mm; projection 0.5 mm. Head dull chocolate brown, perimeter with further porjections orange, centre with seven pale orange patches. Projections larger, hairs longer and pale yellow. Body green, areas lacking setae appearing as longitudinal furrows. Anal projections tipped pale brown.

Fourth instar (Fig. 3). Length (without processes) 14 mm; projections 1 mm. As in third instar but with features more apparent. Anal projections yellow.

Pupa (Fig. 4). Length 12 mm. Pale grey-brown with pale brown mottling, with short lateral projections at anterior end, a pronounced transverse ridge on abdomen, a longitudinal dorsal ridge on thorax and a ridge along each wing case. Abdominal ridge irregular, dark brown. Thoracic ridge smooth, with two dark brown patches. Ridge on each wing case produced anteriorly to a point, with brown patches. Anterior lateral projections and spiracles dark. Suspended by cremaster.

Notes. Eggs laid in late September produced adults in 38 days. Ova hatched in six days, the larval stage lasted 24 days, and the pupal period was eight days.

Larval shelter beneath the leaves of the food plant and feed during the day or night. Pupation occurred on the food plant.

Discussion

To my knowledge *Hypocysta irius* is the first Australian butterfly reported with less than five larval instars. All larva were reared individually and instars counted and confirmed by head capsule counts. *H. irius* were reared on two occasions confirming beyond doubt that this species has only four instars.

Two larvae of *H. angustata* were reared and both had five instars.

The horns of *Hypocysta irius* final instar (fourth) are more prominent than those of *Hypocysta angustata angustata* final instar (fifth).

The pupa of *Hypocysta irius* can be separated from that of *Hypocysta angustata angustata* by an examination of the abdominal ridge. The abdominal ridge of *Hypocysta irius* is irregular and broken. That of *Hypocysta angustata angustata* is uniform and smooth in appearance.

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Common, I. F. B. and Waterhouse, D. F., 1981. *Butterflies of Australia.* Second edition. Angus and Robertson, Sydney. 682 pp.

NEW DISTRIBUTION RECORDS FOR SOME BUTTERFLIES AND HAWK MOTHS FROM FAR NORTHERN QUEENSLAND

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Abstract

New Torres Strait island localities are given for three butterfly species (two Pieridae and one Lycaenidae). The second known female of *Ionolyce helicon hyllus* (Waterhouse & Lyell) (Lycaenidae) is recorded. Two hawk moth species (Sphingidae) are recorded from within Australian limits for the first time.

Introduction

The butterfly and hawk moth species listed below were taken on a field trip to Torres Strait, northern Queensland, during December 1986 and January 1987. Three of the butterflies and one of the two hawk moths were taken on Dauan Island, while the other hawk moth species came from Boigu Island; both these islands lie some 10 km south of the Papua New Guinea coastline. The second known female of *Ionolyce helicon hyllus* is recorded from the Old Lockhart River Mission site, Cape York Peninsula. All specimens are in the author's collection except the female of *I. helicon* which is on permanent loan to the Australian National Insect Collection, Canberra.

Pieridae

Delias mysis onca Fruhstorfer

A single ♀ taken on Dauan Island, Torres Strait, on 8 Jan. 1987 is the third known specimen from within Australian limits; a pair having been previously recorded from Moa Island (Common and Waterhouse, 1981).

Cepora perimale latilimbata (Butler)

A ♂ and ♀ were taken on Dauan Island, Torres Strait, on 8 and 9 Jan. 1987. It has previously been recorded from Darnley and Yam Islands (Common and Waterhouse, 1981).

Lycaenidae

Petrelaea dana (de Niceville)

A ♂ was taken on Dauan Island, Torres Strait, on 9 Jan. 1987. Within Torres Strait this species has been previously recorded on Moa, Yorke, Thursday and Darnley Islands.

Ionolyce helicon hyllus (Waterhouse and Lyell)

A single female taken at the Old Lockhart River Mission site, Cape York Peninsula, on 14 Dec. 1986 appears to be the second recorded ♀ of this subspecies.

Waterhouse and Lyell (1914) described a female of *Ionolyce helicon hyllus* (Waterhouse and Lyell) from Cape York and illustrated the upperside (their Fig. 350). My specimen is similar to the one figured by Waterhouse and Lyell. Common and Waterhouse (1981) reported that G. E. Tite was of the opinion that the true female of *I. h. hyllus* may have a white spot on the fore wing as is found in *I. h. caracalla* (Waterhouse and Lyell) from New Guinea and Darnley Island. However Tite (1963) did not record this opinion and, indeed, pointed out that the subspecies *I. h. caracalla* was the only subspecies with a white spot on the fore wing. Subspecies from localities from Sri Lanka to the islands west of New Guinea are without the white spots as are specimens from the Solomon Islands and Vanuatu. My specimen is quite similar to females from Vanuatu and there seems to be no doubt of its identity.

Sphingidae

Daphnis dohertyi Rothschild

A ♂ was taken by me on Dauan Island, Torres Strait, on 8 Jan. 1987. In the Australian National Insect Collection, Canberra, there are 5 other specimens taken from Torres Strait islands as follows: 3 ♂♂, Warraber (Sue) Island, 18, 19.xii.1977, J. Walker and S. Bakker; 2 ♂♂, Booby Island, 18-19.xii.1977, K. Edlington. These are the first records of this species from within Australian limits.

Eurypteryx molucca Felder

A single ♂ was taken on Boigu Island, Torres Strait, on 6 Jan. 1987 and represents the first specimen to be taken within Australian limits.

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I would like to thank Mr E. D. Edwards for help in the preparation of this paper. Mr M. S. Moulds kindly offered helpful comments on the manuscript.

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SOME NEW LARVAL FOOD PLANTS FOR NORTH QUEENSLAND LYCAENIDAE (LEPIDOPTERA)

By [1]P. S. Valentine and [2]S. J. Johnson
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Abstract

Previously unrecorded larval food plants for sixteen species of lycaenid butterflies are described and reference is made to polyphagy in some ant-attended species.

Introduction

The following notes contribute previously unrecorded information on the larval food plants of sixteen species of lycaenid butterflies found in northern Queensland. In addition an earlier food plant misidentification is corrected.

Food plant records

Hypochrysops narcissus narcissus (Fabricius). Larvae have been reared from two species of mangrove at Yule Point, north of Cairns; *Ceriops tagal* (Rhyzophoraceae) and *Aegiceras corniculatum* (Myrsinaceae). In each case the larvae were attended by small golden ants.

Hypochrysops pythias euclides Miskin. In an earlier account (Valentine and Johnson, 1981) the food plant of this species was considered to be *Triumfetta rhomboidea* (Tiliaceae) from a verbal description by Mr M. De Baar who originally described the larval stages in Australia (De Baar, 1979). Sands (1986) cast some doubt on the validity of *Triumfetta rhomboidea* as a food plant for *H. pythias.* Discussions with Dr Betsy Jackes at James Cook University indicated that *T. rhomboidea* is a coastal plant and would be unlikely to occur in rainforest areas where *H. pythias* flies. Subsequent identifications have shown that the plant on which we have reared *H. pythias* on numerous occasions is in fact *Commersonia bartramia* (Sterculiaceae). This is the same genus used by *H. pythias* in Papua New Guinea (D'Abrera, 1977).

Hypochrysops ignitus chrysonotus Grose-Smith. This species occurs on many hilltops from Townsville north and during July 1986 a small colony was found feeding on *Acacia holosericea* (Mimosaceae) at Mt Kulburn 20 km west of Townsville. Larvae occur commonly on *Planchonia careya* (Lecythidaceae) but have also been found on *Acacia flavescens* (Mimosaceae) and on *Tristania suaveolans* (Myrtaceae).

Pseudodipsas cephenes Hewitson. During February 1986 an adult female was noted flying around a shrub of *Guioa acutifolia* (Sapindaceae) at Bluewater State Forest about 40 km west north west from Townsville and larvae were found feeding on the foliage. Six eggs were collected on the woody stems and were subsequently reared in Townsville on *Smilax australis* leaves to produce three adults of this species and three of *P. eone iole* Waterhouse and Lyell. The larvae of the latter species pupated in about half the time it took the larvae of *P. cephenes.*

Arhopala centaurus centaurus (Fabricius). This species occurs very commonly in the Townsville district and larvae feed on a number of plant species previously unreported. A critical aspect seems to be the presence of green tree ants (*Oecophylla smaragdina*). Adults have been reared from the following plant species: *Terminalia melanocarpa, T. muelleri, T. sericocarpa* (Combretaceae); *Lagerstroemia speciosa* (Lythraceae) and *Dendrophthoe vitellina* (Loranthaceae).

Arhopala madytus Fruhstorfer. Although reared mainly from *Terminalia sericocarpa* it is occasionally found on *T. melanocarpa.*

Arhopala micale amphis. Waterhouse. Also on *Lagerstroemia speciosa.*

Hypolycaena phorbas phorbas (Fabricius). Already known to use many different food plants (see Common and Waterhouse, 1981). The following food plants are previously unrecorded: *Terminalia melanocarpa, Lumnitzera racemosa* (Combretaceae); *Syzygium wilsoni* (Myrtaceae); *Aegiceras corniculatum* (Myrsinaceae) and *Dendrophthoe vitellina* (Loranthaceae). Of particular interest is the discovery of the mistletoe food plant for this species and the two mangrove species (*Lumnitzera* and *Aegiceras*).

Rapala varuna simsoni (Miskin). A single larva of this species was successfully reared from flowers of *Dendrolobium umbellatum* (Fabaceae) in Townsville in February 1984. *Acacia polystachya* (Mimosaceae) is also used in Townsville.

Anthene seltuttus affinis (Waterhouse & Turner). Known to feed on many plant species (see Common and Waterhouse, 1981). The following four are newly recorded: *Brachychiton acerifolium* (Sterculiaceae); *Pongamia pinnata* (Fabaceae); *Syzygium wilsoni* (Myrtaceae) and *Lagerstroemia speciosa* (Lythraceae).

Anthene lycaenoides godeffroyi (Semper). This species has been reared in Townsville from the following new food plants: *Cassia auriculata, C. surattensis* (Caesalpinaceae); *Litchi chinensis* (Sapindaceae); *Dendrolobium umbellatum* (Fabaceae) and *Acacia polystachya* (Mimosaceae). As recorded in Common and Waterhouse (1981) and Valentine (1979) the larvae are usually attended by green tree ants (*Oecophylla smaragdina*) but in Townsville not uncommonly by the small black ant *Paratrechina bourbonica* (Forel).

Candalides helenita helenita (Semper). Larvae were found on *Glochidion ferdinandi* (Euphorbiaceae) southwest of Ingham in February 1986.

Nacaduba kurava parma Waterhouse & Lyell. Larvae were found on the flowers of *Maesa dependens* (Myrsinaceae) at Paluma in October 1983. In Brisbane the flowers of *Cupaniopsis anacardioides* (Sapindaceae) have been used (A. Johnson, pers. comm.).

Theclinesthes miskini eucalypti Sibatani & Grund. Larvae were found on *Acacia flavescens* (Mimosaceae) west of Paluma and on *Acacia holosericea* in Townsville during January 1987. In February 1984, larvae were found on *Sesbania* sp. (Fabaceae) also in Townsville.

Catochrysops panormus platissa (Herrich-Schaffer). This species was reared in Townsville during February 1984 on buds and flowers of *Dendrolobium umbellatum* (Fabaceae) in company with larvae of *Anthene lycaenoides.*

Freyeria trochylus putli (Kollar). During April and May 1985 larvae were very common in Townsville feeding on *Indigofera colutea* (Fabaceae).

Discussion

One feature of particular note is the very wide range of food plants used by butterflies with larvae attended by green tree ants. As a general observation it seems that very many butterfly species with larval stages closely attended by ants are polyphagous. It may also be of interest to note that the record of mistletoe for *H. phorbas* and *A. centaurus* occurred on a *Lagerstroemia* cultivar. The larvae did not feed upon the foliage of this plant but remained on the mistletoe attended by numerous green tree ants.

Acknowledgements

Thanks are expressed to Dr Betsy Jackes from the Botany Department, James Cook University for assistance with plant identification and to Dr R. Taylor (CSIRO, Canberra) for the identity of the *Paratrechina* ants.

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Sands, D. P. A., 1986. *A revision of the genus Hypochrysops C. & R. Felder.* E. J. Brill, Copenhagen. Entomonograph Vol. 7. 116 pp.

Valentine, P. S., 1979. Notes on the biology and distribution of some north Queensland lycaenid butterflies. *Aust. ent. Mag.* 6(3): 55-56.

Valentine, P. S. and Johnson, S. J., 1982. New records of Lycaenidae and Hesperiidae (Lepidoptera) from northern Queensland. *Aust. ent. Mag.* 9(1): 13.

BOOK REVIEW

A revision of the genus *Hypochrysops* C. & R. Felder (Lepidoptera: Lycaenidae). By D. P. A. Sands. *Entomolograph* Vol. 7. 116 pages, illustr. 1986. E. J. Brill/ Scandinavian Science Press. Netherlands. US$38.25.

This revision of the systematics of the genus *Hypochrysops* C. & R. Felder is an impressive contribution to our knowledge of a regionally significant group of butterflies. The author includes 57 species in the genus arranged in 20 groups within which are recognized 110 distinct taxa. Descriptions are given of four new species and three new subspecies and twenty-eight names of species level are placed in new synonymy. The genus *Waigeum* Staudinger is synonymised with *Hypochrysops.* Separate keys are given for males and females of each species and testing the keys for Australian species I found them easy to follow and unambiguous. The only difficulty I experienced was with males of *H. cleon* from Iron Range where I initially ended up in *H. cleonides*! The female *cleon* I have from Iron Range keyed out easily. The male genitalia of all available species (fifty four of the fifty seven) are described and figured with a standard presentation of lateral view, sociuncus, valvae and aedeagus. In a number of instances subspecific variations in male genitalia are also illustrated.

Discussion of each species or subspecies includes a list of synonyms, details of types and notes on distribution and description. For each species a section of comments briefly alludes to distinguishing features as well as details of life history where known. A comprehensive set of references is included.

Of particular interest to Australian students is the recognition of a new subspecies of *theon* from the Rocky River area (*cretatus*). The Claudie River population of *narcissus* is separated from that further south and the Iron Range and Papua New Guinea population of *hippuris* is described as a new subspecies (*nebulosis*). Although *halyaetus* is retained as a single taxon the population sometimes referred to as *uranites* is noted and the prospect for further revision clearly awaits more extensive collection and study. Australian specimens of *miskini* are now seen as distinct from the Papua New Guinea population which is newly described as subspecies *parvulus*. Speculation on the possible presence of *H. arronica* on Cape York, based on a specimen labelled Cedar Bay in the British Museum, I found most interesting.

Two coloured plates with 64 individual photographs illustrate upper and undersides of 23 species including the first illustrations of several previously described species and all four of the new species. A further eight specimens are illustrated (upper and underside) by black and white photographs. The selection of coloured photographs appears to be carefully designed to complement and clarify those already available in Common and Waterhouse (1981) and D'Abrera (1977). This volume will certainly help sort out the confusion present in the latter work.

Overall the quality of this book is excellent both in content and presentation and both Dr Sands and the publisher deserve congratulations. There are a few minor shortcomings including Figures 115 and 116 described as *H. pretiosus pretiosus* instead of *H. protogenes pretiosus* and Figure 2 indicating vein M_1 as vein M_2. It is a pity the captions for the coloured plates did not also include the page reference for each taxon especially as there is ample space. But these minor criticisms in no way detract from the commanding scholarship of this work which will inevitably become the new standard for discussion of these jewels of the butterfly world.

P. S. VALENTINE

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THE LIFE HISTORIES OF *PASMA TASMANICA* (MISKIN) AND *TOXIDIA RIETMANNI* (SEMPER) (HESPERIIDAE: TRAPEZITINAE)

By Andrew Atkins
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Abstract

The early stages of *Pasma tasmanica* (Miskin) and *Toxidia rietmanni rietmanni* (Semper) are descrioed and illustrated.

Introduction

The trapezitine skippers *Pasma tasmanica* (Miskin) and *Toxidia rietmanni* (Semper) are confined to coastal and near coastal forests of eastern Australia. *P. tasmanica* is essentially a montane and subalpine species, and is distributed from northern New South Wales along the Great Dividing Range to western Victoria. It also occurs in montane and coastal Tasmania. Two subspecies of *T. rietmanni* are recognised. The nominal subspecies is distributed from central Queensland to southern New South Wales. Subspecies *parasema* (Lower) is found in the tablelands of northern Queensland. *T. rietmanni rietmanni* frequents rainforests and coastal wet-sclerophyll forests. The adults of both species fly throughout the warmer months of the year, but are more frequently found in spring and autumn. They are generally uncommon species but in some areas they are locally abundant. Their life histories were previously unknown.

Life History

Pasma tasmanica (Miskin), 1889

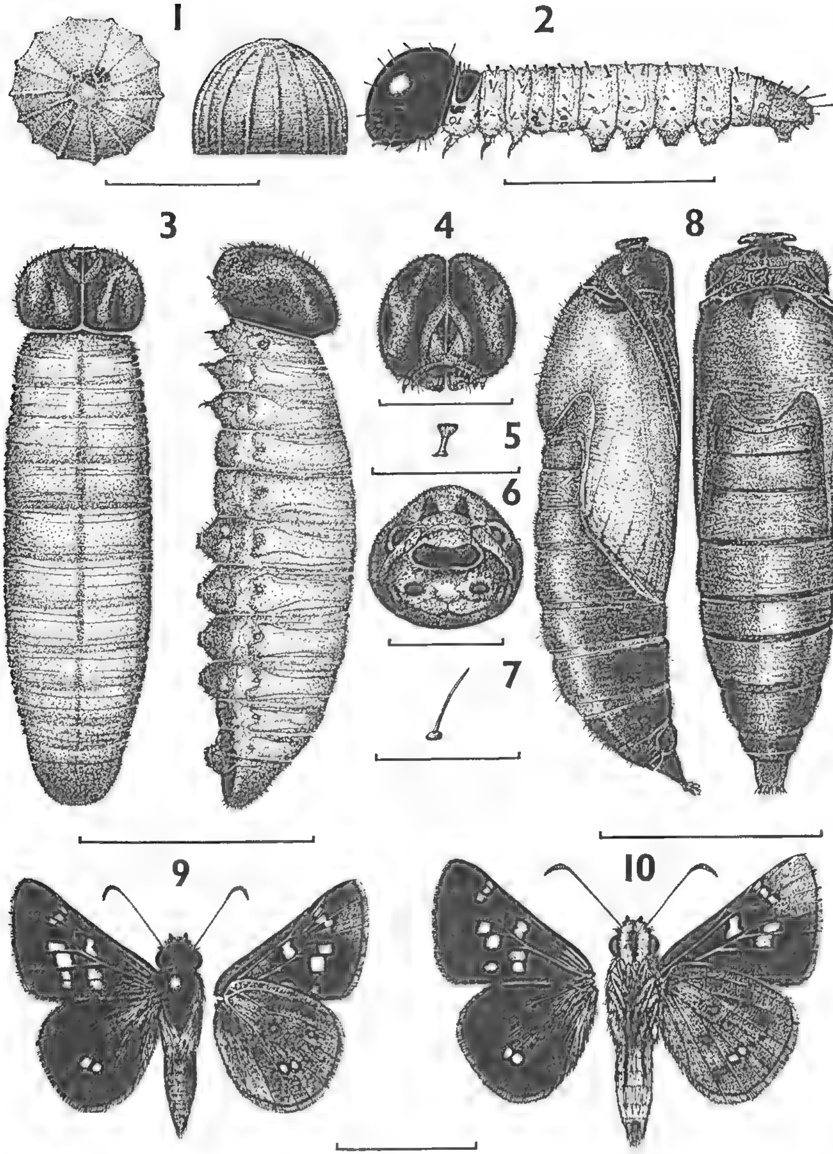
(Figs 1-10)

Foodplant. Unidentified [larvae in captivity feed on a wide range of soft grasses, including *Poa* sp. (Family Poaceae)].

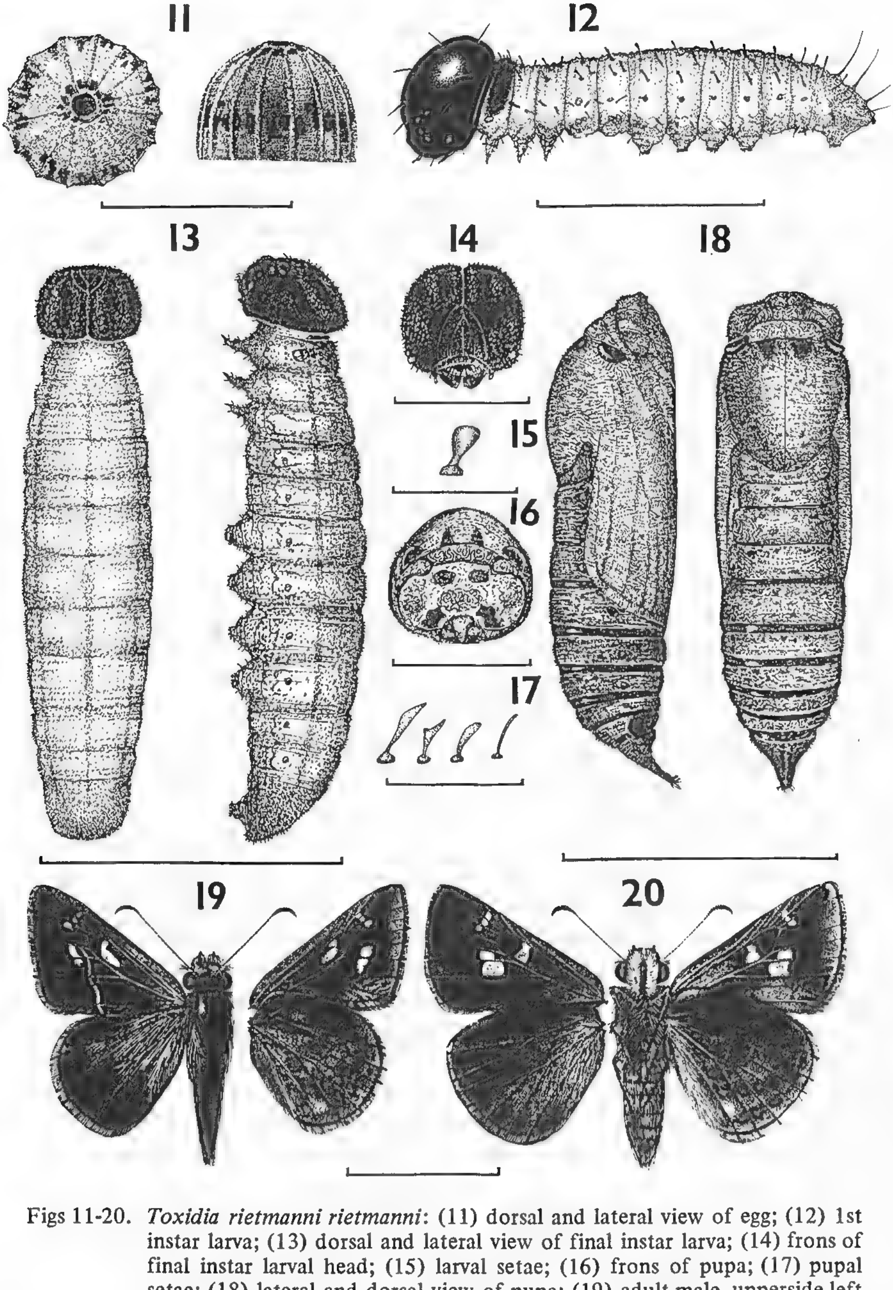
Egg (Fig. 1). Diameter 1 mm, dome-shaped, pale green when first laid, changing in 2 days to cream-coloured with an orange spot near the micropyle; 14 vertical ribs, some broken or converging at the apex.

Larva (Figs 2-7). 1st instar (Fig. 2): length 2 mm; head shining black, covered sparsely with blunt-ended to slightly clubbed setae; prothoracic plate black; body pale cream coloured, covered with short clubbed setae, slightly longer on anal segments. 2nd-5th instars (5th instar Figs 3-5): head dark brown with paired light brown markings on dorsal, lateral and frons surfaces; body reddish brown, lighter brown to green between the segments with a dark brown to black dorsal line; body setae pale, semi-transparent, short and clubbed (Fig. 5).

Pupa (Figs 6-8). Length 16 mm; brown, spiracles black, paired dorsal markings on anterior of thorax dark brown, covered (particularly on anterior surface) with a bluish grey waxy 'bloom', short pale-coloured setae sparsely covering body; pupal cap with a black, laterally-spread, bifid projection, and two ventrally placed black markings.



Figs 1-10. *Pasma tasmanica*: (1) dorsal and lateral view of egg; (2) 1st instar larva; (3) dorsal and lateral view of final instar larva; (4) frons of final instar larval head; (5) larval setae; (6) frons of pupa; (7) pupal setae; (8) lateral and dorsal view of pupa; (9) adult male, upperside left and underside right; (10) adult female, upperside left and underside right. Scale lines: Figs 1, 2 = 1 mm; 3, 8 = 5mm; 4, 6 = 3 mm; 5, 7 = 0.5 mm; 9, 10 = 10 mm.



Figs 11-20. *Toxidia rietmanni rietmanni*: (11) dorsal and lateral view of egg; (12) 1st instar larva; (13) dorsal and lateral view of final instar larva; (14) frons of final instar larval head; (15) larval setae; (16) frons of pupa; (17) pupal setae; (18) lateral and dorsal view of pupa; (19) adult male, upperside left and underside right; (20) adult female, upperside left and underside right. Scale lines: Figs 11, 12 = 1 mm; 13, 18-20 = 10 mm; 14, 16 = 5 mm; 15, 17 = 0.5 mm.

Toxidia rietmanni rietmanni (Semper), 1879
(Figs 11-20)

Foodplant. An unidentified species of soft grass (Family Poaceae).

Egg (Fig. 11). Diameter 0.9 mm, dome-shaped, off-white to pale green, later developing a red-brown micropyle and lateral band; 13-15 vertical ribs.

Larva (Figs 12-15). 1st instar (Fig. 12): length 2.5 mm; head shiny black, pale setae covering dorsal, frons and lateral areas; prothoracic plate brown-black, edged red; body pale yellow, covered with setae, longer on posterior segments. 2nd-5th instars (5th instar Figs 13-15): head dark brown with light brown mottling, sparsely covered with pale setae; body pale reddish grey to pale brown with grey-green to pink between the segments, darker mottling producing indistinct dorsal and dorso-lateral lines; body setae short, pale and clubbed (Fig. 15).

Pupa (Figs 16 - 18). Length 15 mm; red-brown, spiracles black, paired dorsal markings on anterior of thorax and on posterior segments and cremaster black to dark brown, body lightly covered with simple setae; pupal cap sclerotized with two dorsal and one central, slightly raised areas covered with setae.

Notes

Field observations of *Pasma tasmanica* were made in Tasmania, Victoria, the Australian Capital Territory and southern and central New South Wales (specimens were reared from Honeysuckle Creek, A.C.T.). Life history data of *Toxidia rietmanni* were obtained from observations of home-reared specimens collected at Seal Rocks, central New South Wales, and field records made in southern New South Wales and central Queensland. Eggs of both species were obtained by caging females in net-covered pots containing a variety of grasses. The eggs were mostly laid on grass stems and leaf-blades or litter and hatched from 10-15 days. The young larvae made loosely spun shelters in the leaf-blades; the older larvae made tube-shaped shelters within grass blades (*T. rietmanni*), grass stems (*P. tasmanica*), or simply within tightly woven debris at the base of the grass. Pupation generally occured in the latter shelters. Eggs obtained from *P. tasmanica* in November and from *T. rietmanni* in January produced adults in March and October, respectively. This indicates that both spècies are at least bivoltine, especially at low altitudes.

Pasma tasmanica is found locally near spagnum bogs and button-grass plains in sub-alpine areas of the mainland and Tasmania. It also occurs along tussock-sedge watercourses and stream banks at sea level in southern New South Wales and Victoria. Both sexes of this skipper fly in bright sunshine, visiting small flowering herbs. Males establish 'territories', resting on shrubs and tussocks growing near water and in swales. Females are even more solitary in their habits, flying low near streams and marshes inspecting grass tussocks

or occasionally fluttering across sunny meadows. Ovipositing, however, was not observed in the field. Females were often seen in areas heavily grazed by wombats, kangaroos and wallabies in which only large *Poa* tussocks remained. The search behaviour of 'wild' females, indescriminate oviposition sites of caged females, and a larval preference for soft, bladed grasses, indicate that the larvae of this skipper may be opportunistic, feeding on any soft grass growing within the protective environment of large *Poa* tussocks and other dense herbage.

Toxidia rietmanni is generally found on the fringes of rainforest, both at sea-level and in the coastal mountains. The adults of both sexes rest in sunshine on the leaves of shrubs and trees, often 2-3 m above the ground. They frequently visit flowers, such as *Lantana*, in the morning and late afternoon. Males have distinctive flight paths and resting sites. At Seal Rocks females were observed ovipositing on a common species of soft grass growing in the small, sunny clearing of a vine-forest. The eggs were deposited singly beneath leaf blades, on grass stems or nearby debris. In coastal localities there are probably at least three generations each year.

The morphology of juveniles and adult *Pasma tasmanica* and *Toxidia rietmanni* clearly place both species in the Trapezitine subsections of the Trapezitinae (see Waterhouse, 1932; Atkins, 1973).

Acknowledgements

I am grateful to Dr Don McNiel, California, for his field assistance in locating females of *Pasma tasmanica* at Honeysuckle Creek in areas made somewhat hazardous by the presence of several elapid snakes belonging to three species.

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NOTES ON THE DISTRIBUTION AND BIOLOGY OF *THERYAXIA SUTTONI* CARTER (COLEOPTERA: BUPRESTIDAE)

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Abstract

Theryaxia suttoni Carter is now known to occur in Queensland and New South Wales. *Callitris glaucophylla* Thompson and L. Johnson is the larval host of *T. suttoni* in both states.

Introduction

Carter (1928) described the monotypic genus *Theryaxia* and its type species *T. suttoni* from specimens collected at Stanthorpe in Queensland. *T. suttoni* is poorly known in collections and very little is known of its biology. As far as we are aware *T. suttoni* has only been recorded from two localities, Stanthorpe and Chinchilla, both in south-eastern Queensland (Carter 1928, Hawkeswood 1986). Recently, Hawkeswood (1986) recorded *Callitris glaucophylla* Thompson & L. Johnson as the host of *T. suttoni* at Chinchilla. We provide, below, further data on distribution and biology of this jewel beetle.

Observations and Discussion

On 31st July 1984 one of us (JAS) collected several small billets of recently felled *C. glaucophylla* near Lanes Mill Broom Flora Reserve, in the Pilliga East State Forest, approximately 48 km south-west of Narrabri, New South Wales. Billets were taken from trunks and larger branches wherever insect damage or larvae were found. The felled trees had been scorched in a forest fire earlier in the year. Billets were transported back to the laboratory and stored in wire-mesh rearing cages at room temperature.

On 12th and 13th October, 1984 adult *T. suttoni* emerged. Later adult *Ceresium* sp. (Cerambycidae) also emerged (15th Nov. 1984-10th Jan. 1985) as well as the parasitic wasp, *Helcon rufithorax* (Turner) (Braconidae) (29th Oct.-14th Dec. 1984). However, neither of the common cypress pine jewel beetles, *Diadoxus erythrurus* (Wade) or *Diadoxus scalaris* (Laporte and Gory) emerged from these billets, but billets collected from fire-killed trees in January 1983 from the same locality were infested by *D. erythrurus.*

T. suttoni is now known from three localities in south-eastern Queensland, Stanthorpe, Chinchilla and Western Creek near Milmerran (F. R. Wylie pers. comm.), and from Pilliga East S.F. in New South Wales all within the range of its only known host, *C. glaucophylla.* Since *C. glaucophylla* is widely distributed throughout central southern Australia (Thompson and Johnson 1986) it is probable that *T. suttoni* is much more widely distributed than is presently known.

C. glaucophylla is the larval host of a wide range of wood-boring beetles (Brimblecombe 1956, Hadlington and Gardner 1959, Hawkeswood and Peterson 1982, McKeown 1942, Moore 1972, Webb 1987). Given that many of these species may occur in the same locality and that, in this case, at least

two species emerged from the same billets, competition between species may occur. Further study of boring patterns and emergence times of beetles co-inhabiting *C. glaucophylla* timber may help to explain how competition is avoided.

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